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Income Poverty Effects of Expansion and Policies in Cash Cropping Economies in Rural Mozambique: An Economy-wide Approach

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Research Report No. 64

2007

Republic of Mozambique

DIRECTORATE OF ECONOMICS

Research Paper Series

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ACKNOWLEDGEMENTS

The Directorate of Economics is undertaking collaborative research on food security with Michigan State University's Department of Agricultural Economics. We wish to acknowledge the financial and substantive support of the Ministry of Agriculture and Rural Development of Mozambique and the United States Agency for International Development (USAID) in Maputo to complete food security research in Mozambique. Research support from the Bureau of Economic Growth, Agriculture and Trade program of USAID/Washington also made it possible for Michigan State University researchers to contribute to this research. Additional financial support was provided by Italian Cooperation in Mozambique through CEPAGRI, and the Ministry of Agriculture of Mozambique. This report does not reflect the official views or policy positions of the Government of the Republic of Mozambique, nor of USAID, nor of Italian Cooperation.

This study was done in very close collaboration with the Department of Policy Analysis (Directorate of Economics) and CEPAGRI (Centre for the Promotion of Commercial Agriculture) in the Ministry of Agriculture. Logistical support was provided by the Tete Province Branch of the Department of Economics of the Ministry of Agriculture. We also gratefully acknowledge the field assistance provided by DUNAVANT-Mozambique and *Companhia Nacional do Algodão* (cotton companies in Tete) and Mozambique Leaf Tobacco and DIMON-Mozambique (tobacco companies).

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NOTE

This document is a reprint of Chapter 4 of Rui M.S. Benfica's (2006) Ph.D. dissertation in the Department of Agricultural Economics at Michigan State University. It includes an Executive Summary, and was reformatted to be published as a stand alone piece. The data utilized for this study—the Social Accounting Matrix (SAM) for Contract Farming (CF) Concession Areas in the Zambezi Valley of Mozambique—was built using data from the Rural Household Survey in Cotton and Tobacco Concession Areas collected in two rounds with 300 farming households in the 2003/4 agricultural season. It also uses secondary data and expenditure shares from the National Expenditure Survey for 2002/3.

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Income Poverty Effects of Expansion and Policies in Cash Cropping Economies in Rural Mozambique: An Economy-wide Approach

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EXECUTIVE SUMMARY

Poverty is widespread in Mozambique, particularly in rural areas where the highest proportion of the population lives and work. Livelihood strategies among rural HHs in the Zambezi Valley are predominantly based on agricultural activities, but income diversification is increasingly important. Cash income from agriculture comes predominantly from tobacco and cotton production. Due to cash constraints and poor access to input and credit by farmers, and high demand from buyers to meet quality and volume requirements, contract faming is the dominant form in the organization of transactions in those cash cropping sectors. The selective nature of CF implies that not all HHs may have the chance to directly participate in these schemes; some HHs are excluded. A key question, then, is how large and widespread the indirect income effects of these schemes are, compared to the direct effects. The answer to these questions has a lot to say about the poverty reduction effects of such crops, and may generate insights about policies and programs to enhance these effects.

The general purpose of this study is to help guide the government and donors in their decisions to allocate development resources to induce private sector investments that yield high profits to firms while generating broad-based income growth and poverty reduction. we used an economy-wide model to account for feedback effects and evaluate the income poverty effects on different HH groups of expansion and exogenous shocks in cash cropping sectors.

This study uses data from a two-round survey undertaken with HHs in tobacco and cotton concession areas of the Zambezi Valley of Mozambique. The study also uses HH consumption data from the National Expenditure Survey (IAF 2002/3) to derive HH expenditure shares, and secondary data for the cotton and tobacco sectors, both at the aggregate and firm level. The HH level survey collected data on the level of intermediate input use and the variation in factor use, particularly seasonality in labor demand and HH decisions with respect to the use of family or wage labor and its allocation across competing activities. The survey also collected data on production and marketing of crops, livestock, fishing, non-farm enterprises and wage labor, asset ownership, and remittance income. The data collected were used for the construction of a Regional Social Accounting Matrix for the Zambezi Vally (ZVR-SAM); this SAM served as the database for a Regional Computable General Equilibrium (ZVR-CGE) model developed to undertake policy simulations.

The ZVR-CGE model introduced in the analysis was intended to investigate the effects on income growth and poverty reduction of cash crop expansion and of a series of exogenous events hypothesized to take place during expansion. Expansion was simulated as an increase in capital endowments specific to cash cropping sectors. The other exogenous shocks simulated were selected on the basis of current issues that are considered relevant for the sectors. They include increases in productivity, increase in export prices for tobacco, cotton and maize, increase in import prices for input, and a government imposed tax on cash crop exports. The discussion of policy implication in the next section contextualizes each of these shocks.

In the CGE model we assumed full employment of activity-specific capital and unemployment with full mobility of all other factors. Model simulations suggest that growth rates of income and poverty reduction effects of expansion and exogenous shocks are sizable in both areas, but larger in tobacco areas.

In tobacco areas, an expansion of 15% combined with a 15% increase in export prices yields a greater impact than the same expansion with productivity gains of 15%. In fact, expansion with higher world prices results in an increase of 49% in per capita income of non-growers and 79% in the income of tobacco growers. Expansion with increased productivity results in relatively lower, but still significant, growth rates of 43% and 62%, respectively. Model results indicate that this growth in per capita income of HHs (growers and non-growers) results from a number of linkage effects. Initial expansion in the sector generates an increased level of economic activity across all sectors, including non-tobacco agricultural activities and non-farm activities. The relatively higher level of economic activity results in greater remunerations for grower and non-grower groups alike, via the increased demand of factors by those activities.

In contrast, in cotton growing areas, where productivity is extremely low, expansion with productivity gains has a relatively greater impact than expansion with increases in world market prices. Growth in per capita income for cotton non-growers and growers is 31% and 40%, and 21% and 24%, respectively. Model results indicate that productivity gains (compared to price increases) in cotton areas generate a relatively higher and broader (beyond cotton itself) growth in the level of economic activity across all sectors. That translates in an increase in the volume of cotton that is proportionally greater than the increase in price simulated, implying higher income to grower farmers. The relatively higher level of economic activity results in greater remunerations for grower and non-grower groups alike. It appears that the more efficient use of labor in cotton has important implications for other sectors as well. In fact, those activities are able to use more labor as a result, i.e., they exhibit a greater growth (in percentage terms) in labor demand although absolute base levels are typically higher in cotton production itself. We concluded that productivity increases in the cotton sector lead to good prospects for expansion in other sectors as well, and that it can potentially be beneficial to non-growers, even when benefits to growers are limited.

Adverse events, such as input import price increases and export taxes, slow down poverty reduction effects significantly. The damages of increased input prices are more severe in tobacco growing areas, where the input package is substantially more expensive. The effects of an export tax are more severe in tobacco growing areas where it significantly slows down the effects of otherwise successful expansion efforts. In both areas, better maize prices have very positive implications for poverty reduction.

The ZVR-CGE model results confirm several indications from the econometric analysis. First, effects of the cash crop on non-grower income growth and poverty reduction, though lower relative to grower groups, are significant. Greater demand for factors in response to increased demand for farm and non-farm goods and services, and its subsequent remuneration to HH groups explains these broad-based effects. Second, relative effects in favor of grower groups are more accentuated in tobacco areas than in cotton areas, confirming that grower HHs in tobacco areas are not giving up on profitable non-farm opportunities that expand significantly as cash crop production expands.

In general, the cotton and tobacco sectors in Mozambique have provided a great deal of the rural population in concession areas with a secure source of cash income in areas where alternative income-generating activities are limited. These cash crop sectors are currently faced with a number of pressing issues. This section looks at those issues as they relate to the analysis presented in this study and the relevant implications for poverty reduction in the study region. Such issues include the effects of a proposed tobacco export tax on rural

poverty; the implications of a cotton sector recovery that relies on enhanced productivity; labor migration and growth of the tobacco sector; and a set of general issues such as maize trade, input distribution, and environmental and technological spillovers.

First, a proposal to impose an export tax on raw tobacco, as a way of encouraging domestic processing, has been the object of great controversy in recent years. Benfica et al. (2005) discuss the implications of that policy in a cost-benefit framework, and conclude that the imposition of such a tax at this stage of the development of the tobacco sector is not appropriate, and suggest that other ways to promote investments in processing be found without compromising the long-term sustainability of the sector. Findings in this study strongly reinforce this recommendation: a 15% export tax would eliminate any income gain to grower HHs from a 15% expansion of the tobacco sector, and would reduce income gains to non-growers from 18% to 6%. It is, therefore, recommended that the government not embark on such a policy as it is not consistent with its ultimate poverty reduction objectives.

Second, regarding the cotton sector, where current yields and overall profitability are low, economy-wide simulation results indicate that productivity gains in cotton have a broad-based income growth and poverty reduction effect, even greater than increased world prices. On a policy standpoint, because sustained increases in world prices are unlikely, this result is encouraging. This study suggests that maximizing the contribution of cotton to smallholder livelihoods will require increased productivity at the farm level that can come about through improvements in the seed stock (quantity and quality), as well as in the input package, extension, and prices to farmers. Also, reforms currently underway need to be participatory and be given top priority by stakeholders (public and private) interested in the sector and in smallholder welfare, in order to better explore the available alternatives.

Third, the successful expansion in tobacco production has been possible due to the readily available labor in border areas that is knowledgeable of tobacco cropping. Circumstantial evidence suggests that this labor force is a mixture of returned refugees (established in Malawi during the Mozambique Civil War), family members of these returnees, and a genuine new generation of Malawian migrant laborers, many of whom are former tobacco smallholders in Malawi that find the wage labor opportunities in Mozambique more profitable. In terms of our model, these patterns of employment raise concerns about possible consumption leakages; the corollary in popular sentiment is that this income should be going to Mozambicans, not Malawians. Yet, over 75% of the so called “Malawians” report spending 9 to 12 months working in Mozambique, which suggest that a great deal of their annual consumption takes place in Mozambique. In practice, our study suggests that income leakage is not a major problem, and availability of Malawian labor is important to the growth of the sector. A policy implication is that efforts to ensure that Malawi migrants gain some kind of permanent residency that leads them to spend more time and resources in the Mozambican territory can be helpful to feed expansion of the sector and spread its benefits in the local economy.

It is worth pointing out a set of additional policy considerations. First, maize is important both as a food security crop and a cash crop in these areas. Simulation results indicated that better export prices for maize reduce poverty in all areas and across all groups. Therefore, a continuation of a policy that does not restrict trade both in-country and across national borders is important. Second, although results indicate limited negative effects of high import prices for input, particularly in cotton areas, where the input package is relatively cheaper, measures aimed at reducing the costs of importation and transport are highly encouraged, as

they can help minimize any negative effects from factors outside the control of domestic agents. Finally, the issue of technological and environmental spillovers requires more attention. On the positive side, survey results indicate that the use of fertilizers on maize by non-growers of tobacco in tobacco areas is very positive, given the strategic importance of that crop for poverty reduction and HH food security. On the negative side, tobacco expansion leads to extensive tree cutting. Survey data indicate that the rate of tree cutting by tobacco growers far surpasses the rate of planting. If those trends are not halted, the long term consequences can be catastrophic. Specific actions to contain or reverse the situation are required.

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LIST OF ACRONYMS

CDF	Cumulative distribution function
CDN	Commodities without domestic sales
CEN	Commodities not exported
CEPAGRI	Centre for the Promotion of Commercial Agriculture
CES	Constant elasticity of substitution
CF	Contract farming
CGE	Computable general equilibrium
C.N.A.	Companhia Nacional Algodoeira
CPI	Consumer price index
DAD	Distributive Analysis/Analyse Distributive Software
DAP	Department of Policy Analysis
DINA	Direcção Nacional de Agricultura
FMC	Factor market closures
FACTFE	Factor is activity specific and fully employed
FMOBFE	Factor is mobile and fully employed
FMOBUE	Factor is mobile and unemployed
GAMS	General Algebraic Modeling System Software
GDP	Gross domestic product
GOM	Government of Mozambique
GOV	Government
GTAP	Global Trade Analysis Project
ha	Hectare
HH	Household
IAF	Inquérito aos Agregados Familiares/Household Expenditure Survey
IFPRI	International Food Policy Research Institute
INE	Instituto Nacional de Estatística
IRN	Imposto de Reconstrução Nacional
LEO	Leontief
LES	Linear expenditure system
MA	Ministério da Agricultura/Ministry of Agriculture
MC	Marketing costs
MLT	Mozambique Leaf Tobacco
MPF	Ministry of Planning and Finance
MS	Micro-simulation
PRSP	Poverty Reduction Strategy Paper
RH	Representative household
RoW	Rest of the world
SAM	Social accounting matrix
SI-B	Savings investment balance
SKM	Square kilometer
ZVR-CGE	Zambezi Valley Regional Computable General Equilibrium Model
ZVR-SAM	Zambezi Valley Regional Social Accounting Matrix

1. INTRODUCTION

Econometric analysis indicates that growth in cash cropping, especially tobacco, can potentially affect income differentiation between growers and non-growers. Tobacco might reduce differentiation by providing high returns to HHs not engaged in remunerative off-farm activities, and by providing wage labor opportunities to more HHs. At the same time, it could contribute to differentiation by driving the growth of a group of relatively large, "emergent" tobacco farmers. The relative magnitude and direction of each of these effects depends to a great extent on the nature of second-round effects that result from employment, production, and consumption linkages in those economies.

We used an economy-wide framework to analyze changes in the levels of income poverty of different HH groups following certain exogenous shocks to the cotton and tobacco sectors. These shocks include expansion of CF through capital injections, technology improvements, changes in world market prices, and changes in the government trade policies. These issues are addressed using a regional agricultural CGE model in the tradition of Lofgren and Robinson (1999) and Taylor, Yunez-Naude, and Dyer (1999), which we developed and calibrated with a regional SAM). The model focuses on the Zambezi Valley area, which has received much of the new investment in these sectors over the past decade.

Macro economy-wide models, normally designed to capture the second and higher feedback effects of investment and policy changes, have been used to analyze a wide range of issues in Mozambique, such as aid dependence, marketing and agricultural technology (Tarp et al. 2002), the effects of HIV/AIDS, and the effects of multilateral trade agreements (Arndt 2002; Arndt 2005). However, macro level economy-wide models, including national CGE models, typically abstract from local economies, and do not provide the detail needed to uncover the full impact of policy changes on rural economies. This is especially true when agricultural HHs are engaged in a portfolio of farm and non-farm activities (Taylor, Yunez-Naude, and Dyer 1999), and when the analysis of issues and/or the impact of shocks that are specific to a relatively small region.

Section 2 explains the relevance of the study for pro-poor growth policy strategies. Section 3 presents the data and analytical methods that include the regional SAM, the regional CGE model, a discussion on interlinked transactions, and a conceptual framework for the representative household (RH) approach to poverty analysis used in this study. Using SAM and HH survey data, representative characteristics of the regional economy are presented in section 4. Section 5 focuses on the definition and set up of the various policy and technology/investment options that form the basis for the analysis, and the presentation and discussion of results. Section 6 closes with conclusions and policy implications.

2. RELEVANCE FOR PRO-POOR GROWTH POLICY

Poverty reduction policy statements in Mozambique (GOM 2001; GOM 2005) recognize that agro-industrial investments and export-oriented agriculture can play a role in reducing rural poverty. What these statements lack is specific knowledge that would help sketch strategies to enhance the impact of these investments on rural poverty in a consistent and sustainable way. Current agro-industrial and agricultural export-oriented investments in the country demonstrate various degrees of connectedness with rural HHs. The total impact of such investments or policies designed to promote them depends on the size of the direct and indirect/induced effects in a particular region (Hazell 1984; Rogers 1986; Haggblade, Hazell, and Brown 1987; Delgado, Hopkins, and Kelly 1998). Alternative supply chain institutional arrangements, ranging from the reliance on independent producers in spot markets, to various forms of alliances and contracting, to full vertical integration, will generate various degrees of initial employment and income effects, depending on the crop and supply chain in question.

An important question for policy makers refers to the magnitude of the secondary effects from investments, i.e., the size of production, consumption, and employment linkages in the local economy. If those effects are expected to be strong, pro-poor economic growth strategies need not be directly or exclusively oriented to the poor. Furthermore, in an environment characterized by serious resource constraints, and bearing in mind that it is normally more expensive to reach the poor than the relatively more endowed, a growth strategy that emphasizes second-round effects in rural poverty reduction may, if these effects are large, be preferred to one that focuses solely on the maximization of direct effects to the poor (Tschirley 2002; Benfica, Tschirley, and Sambo 2002; Carrilho et al. 2002).[1] The validity of this conclusion, that poverty reduction may be achieved at a lower cost when emphasis is given to second-round effects, depends to a great extent on the structure of the economy where growth takes place that influences the relative costs and benefits associated with alternative investments and policy options. The preferred approach becomes, therefore, an empirical question. This study looks at that question using data from the Zambezi Valley region of Mozambique where cash crops are grown under contract, and baseline data allows for stratification of farming HHs and the subsequent analysis of relative impacts of policy changes on income poverty levels.

[1] This is due to the greater difficulty in reaching the poor with messages on innovative technologies, but more importantly due to the lesser ability of the poorest HHs to make the adjustments and bear the risks needed to adopt new technologies. Indeed, rational policy makers attempting to reduce poverty in the face of a budget constraint will rely more on indirect effects than they would if costs to reach all groups were equivalent (Tschirley 2002).

3. DATA AND ANALYTICAL METHODS

This section presents the data and analytical methods used in this study, including the Regional SAM for the Zambezi Valley (ZVR-SAM), the Regional CGE model (ZVR-CGE), including its standard structure, and a discussion on interlinked transactions in selected cash cropping activity sectors. Then, it presents a conceptual framework for the RH approach to poverty/inequality analysis. Finally, it discusses issues related to the design and implementation of policy simulations with the CGE model.

3.1. The Regional SAM for the Zambezi Valley

3.1.1. Introduction

A SAM is both a data system and a conceptual framework useful for policy analysis (Thorbecke 1998).[2] SAMs have been used to model diverse economies and institutional structures within various geographical scopes. Initial applications were mostly modeling macro level issues in a national accounting context; more recently the framework has been adapted to study micro (villages and towns) and sub-national (or regional) economies. The strengths of the SAM framework are in its flexibility and adaptability to model a variety of economic structures and institutional setups. As a data system, SAM is *comprehensive* and disaggregated, as it includes transactions among sectors, factors, and institutions; *consistent* in the sense that for every income there has to be an equivalent expenditure; and *complete* in that both the sender and the receiver of every transaction need to be identified. For a given year, SAM provides a snapshot of the structure of the economy under investigation: the structure of production, inter-sectoral linkages, distribution of factor value added among socio-economic groups, and their expenditure patterns. The SAM framework consists of a square matrix of double-account, in which rows represent receipts (revenues) and columns represent expenditures (payments). As a *comprehensive*, *consistent*, and *complete* accounting method, it requires balancing revenues and expenditures in all accounts.[3]

3.1.2. The Structure of the Regional SAM

ZVR-SAM keeps all the features of a standard SAM. Some important ones are: the inclusion of non-marketed home-consumed commodities by farm HHs; the explicit treatment of MCs; and the separation between production activities and commodities that allows any activity to produce multiple commodities and any commodity to be produced by multiple activities. In addition, SAM has two other distinctive characteristics. First, to account for the diversity of rural production activities, demand patterns, technologies, and market structures, SAM is highly disaggregated. In total, it includes 83 accounts. Second, agricultural activities (farm types) are mapped with HH types. This allows for better integration and subsequent modeling

[2] The genesis of SAM dates back to Sir Richard Stone's (1978) pioneering work on social accounts, for which he received the Nobel Prize in Economics in 1984 (http://nobelprize.org/economics/laureates/1984/index.html). Subsequently, Pyatt and Round (1979) further formalized SAM and showed how it could be used as a conceptual framework for policy and planning purposes.

[3] Issues regarding the process of constructing the regional SAM for the Zambezi Valley and the balancing procedure used to ensure the required accounting consistency are discussed in Chapter 2 of Benfica (2006).

in a CGE framework of production and consumption decisions in a non-separable fashion with the relevant differentiation across farm-HH types and activities (Lofgren and Robinson 1999; Taylor, Dyer, and Yunez-Naude 2005).

The 2003/4 ZVR-SAM includes six major types of accounts: (i) activities; (ii) commodities; (iii) commodity MCs; (iv) factors of production: labor, land, and capital; (v) institutions: HHs, government, and the rest of the world (RoW); and (vi) savings and investment. A schematic view of SAM is presented in Table 1.

The *Production Activities* accounts describe the value of commodity inputs and the payments to factors used in the production process (columns) and domestic market sales and home consumption of goods and services (rows). ZVR-SAM includes 18 such accounts. There are six accounts for agricultural farms, four of which represent cash cropping farms: two tobacco farm types and two cotton farm types. The remaining two represent non-growers of cash crops in the respective areas. Other activities include fishing, livestock, food processing, beverage processing, other processing or manufacturing activities, trading services, government services, and other services. Finally, we included four marketing and exporting activities representing each of the four firms that operate CF schemes, supplying input on credit and buying back the output that is subsequently exported after adding some value.

The *Commodities* accounts record the value of total supply, including the value of domestic production marketed and imports after taxes and marketing margins (columns) and total demand, including demand for intermediary input by activities, private and government consumption of goods and services, investment demand, and exports (rows). We have 45 commodity accounts. The major cash crops are represented by eight accounts, reflecting a high level of disaggregation with firm-specific raw tobacco accounts, raw cotton accounts, and another similar set of accounts for packed/graded tobacco and cotton.[4] Other accounts represent agricultural raw and semi-processed food commodities ranging from maize grain and meal to fruits and vegetables (eight), animals and animal products (six), processed foods (six), agricultural inputs (four), non-food items (nine), and services, ranging from health and education to maintenance (four).

Marketing Costs (MC)/marketing margin accounts quantify the wedges between production and market prices for domestically produced goods sold domestically, between import border prices and domestic market prices for imported commodities, and between domestic and export border prices for exported goods. In principle, they account for both transportation and the intangible costs of doing business, including procurement, contract negotiations, etc. SAM includes three relevant MC accounts: MC for domestic sales, MC for imports, and MC for exports. These accounts get payments from the tradable commodity accounts (rows) and make payments to a trading services commodity account (columns).

The *Factor* accounts describe the source of factor income, i.e., value added in each domestic activity and from the RoW and how factor payments are distributed to the various institutions, including the different HH groups and the RoW in proportions reflecting factor endowments (column). ZVR-SAM includes factor accounts for land (one), capital (five), and labor (four) resources. The labor accounts correspond to two labor types (family and hired labor) represented on a temporal dimension, i.e., each labor account is disaggregated to account for labor use and remunerations for the *pre-harvesting*, the *harvesting, and post-*

[4] Note that packed tobacco and packed cotton are entirely exported.

harvesting season, respectively. This allows for the analysis of seasonality in labor demand and payments to institutions. The capital account is divided in four activity specific accounts, each associated with a cash crop farm account, and one general capital account associated all other activities.

The *Institutions* accounts comprise all the income and expenditures of HHs, government, and the RoW. The *HH* accounts record income, i.e., the value of domestic factor income to HHs, inter-HH transfers, subsidies or transfer payments from the government, and remittances from the RoW (row), and how HHs spend that income: HH home-consumed output from the activities they engage in, consumption expenditures of marketed goods and services, transfers to other HHs, payment of taxes, private savings, and remittances to the RoW (column). The disaggregation of HHs in the regional SAM is aimed at representing the dominant production structure implied by the classification of activities. With that in mind, we disaggregated the HHs in four major groups: (i) tobacco growing HHs: farming HHs in tobacco areas that engage in tobacco production under contract with Mozambique Leaf Tobacco (MLT) or DIMON-Mozambique; (ii) cotton growing HHs: farming HHs in cotton areas engaged in cotton production under contract with DUNAVANT-Mozambique or C.N.A.; (iii) non-tobacco growing HHs in tobacco growing areas; and (iv) non-cotton growing HHs in cotton growing areas. Each HH group engages in a portfolio of activities including food crop production and non-farm businesses, or some form of wage labor.

Typically, the *Government* accounts collect taxes on income from activities, commodities, factors, and transfers from the RoW (row), and pay for government consumption of goods and services, transfers to HHs and to the RoW (column). The role of the government in this regional model is limited. In reality, the flows of the government account in a sub-national SAM should reflect the actions of two actors—the local and the central government. The central government in this SAM is located in the "RoW." For simplicity, we considered a single government account representing a regional government. Income sources for the local government include the collection of a flat lump-sum tax *per capita* in the region and a substantial inflow from the "RoW" that includes the central government. In the base year that SAM represents, there are no activity or commodity taxes on domestic or foreign trade. Local government expenditures include transfers to HHs in the form of pensions, and expenses in health and education at the local level.

The *RoW* accounts record payments to the RoW for imports of goods and services, the use of foreign factors, and government transfers (row), and receipts from exports, factor payments to domestic factors, remittances to HHs, transfers to government and foreign savings (column). Like in the case of the government, the spatial definition of SAM implies the existence of at least two RoW institutional accounts; the "RoW" representing the rest of the national territory, and the "Foreign RoW" that represents agents outside Mozambique. The ZVR-SAM, however, includes only a single RoW account that covers all the areas outside the region, domestic and foreign. The base year that SAM represents does not include any taxes or tariffs on trade between the region and the RoW.

Table 1. Schematic Standard Regional SAM

		EXPENDITURES								
		Activities	Commodities	Marketing Costs	Factors	Representative Householdss	Local Government	Savings/ investment	RoW	Total
RECEIPTS	Activities		Domestically marketed output			Home consumption				Gross output
	Commodities	Intermediate inputs purchased		Transaction costs		Consumption expenditures	Government consumption	Investment demand	Exports	Commodity demands
	Marketing Costs		Marketing costs							Marketing costs
	Factors	Value added: wages/rents					Wages/rents paid by GOV		Wages/rents from RoW	Total factor earnings
	Representative Households				Factor income to HHs	Intra-HH transfers	GOV transfers to HHs		Remittances from RoW	HH income
	Local Government	Producer taxes, value added taxes	Sales taxes, tariffs, export taxes		Factor taxes	Personal taxes			Transfers from RoW and Central GOV	Government receipts
	Savings/ investment					HH savings	Government savings			Total savings
	Rest of World		Imports		Factor income paid to RoW	Remittances to RoW				Payments to outside region
	Total	Total costs of production	Domestic supplies	Marketing costs	Factor expenditures	HH expenditures	Government expenditures	Total investment	Total receipts from outside	

Source: ZVR-SAM, adapted from Lofgren, Harris, and Robinson 2002

The *Savings-Investment* account records the savings made by all the institutions (row) and how they are spent in investment goods (column). Detailed lists of accounts and levels of disaggregation for the ZVR-SAM are presented in Tables 2 and 3. The SAM database is used to calibrate the ZVR-CGE model detailed later in this section.

Table 2. Regional SAM Accounts: Activities, Commodities, and Marketing Costs

Accounts	Description of Individual Accounts	
Activities	***Agriculture and Livestock/fishing:*** Tobacco growing farms - MLT Tobacco growing farms - DIMON Cotton growing farms - C.N.A. Cotton growing farms - DUNAVANT Non-growers - tobacco areas Non-growers - cotton areas Livestock Fishing ***Processing/manufacturing:*** Food processing Beverage processing Other processing/manufacturing	***Marketing/export of Cotton and Tobacco:*** MLT - Tobacco marketing and export DIMON - Tobacco marketing and export C.N.A - Cotton marketing and export DUNAVANT - Cotton marketing and export ***Transportation and Services:*** Trading services Government services Other services
Commodities	***Cash Crops:*** Raw cotton – DUNAVANT Raw cotton – C.N.A. Packed cotton – DUNAVANT Packed cotton – C.N.A. Raw tobacco – MLT Raw tobacco – DIMON Packed tobacco – MLT Packed tobacco – DIMON ***Other Agricultural Raw and Processed Commodities:*** Maize grain and rice Maize meal Other flours Bread/biscuits/pasta Beans and groundnuts Root crops: cassava/potatoes Vegetables, green leaves and fruits Coconuts ***Animals and Animal Products:*** Meat - cow Meat - goat Meat - pork Meat - birds Fish and sea river foods Milk and eggs	***Processed Foods/beverages:*** Cooking oil Sugar Salt Tea/coffee and spices Prepared ready-to-eat foods Alcoholic beverages ***Services:*** Education Health Trading services Housing/water/electricity/maintenance ***Agricultural Inputs:*** Seeds - other products Pesticides - Cepermetrin + Acephate Fertilizers - NPK + CAN + UREA Other inputs ***Non-foods and Other Commodities:*** Firewood and coal Fuel - vehicles/equipment/spares Wood/grass/cane products Textiles, wearing apparels and footwear Metal/blacksmithing products Kitchen utensils and other home apparel Soap and hygiene products Imported tobacco Other commodities
Marketing Costs	Domestic Sales Imports Exports	

Source: ZVR-SAM

Table 3. Regional SAM Accounts: Factors, Institutions, and Savings-Investment

Accounts	Description and Level of Disaggregation	
Factors	Land	Land
	Capital	Capital (general) Farm specific - MLT Farm specific - DIMON Farm specific - DUNAVANT Farm specific – C.N.A.
	Labor	Family labor – Pre-harvesting Family labor – Harvesting and marketing Hired labor – Pre-harvesting Hired labor – Harvesting and marketing
Institutions	Government	Local government
	RoW	Domestic and foreign RoW
	HHs	Cotton areas: Non-grower HHs Cotton areas: Grower HHs Tobacco areas: Non-grower HHs Tobacco areas: Grower HHs
Savings-investment	Savings-investment	Savings-investment

Source: ZVR-SAM

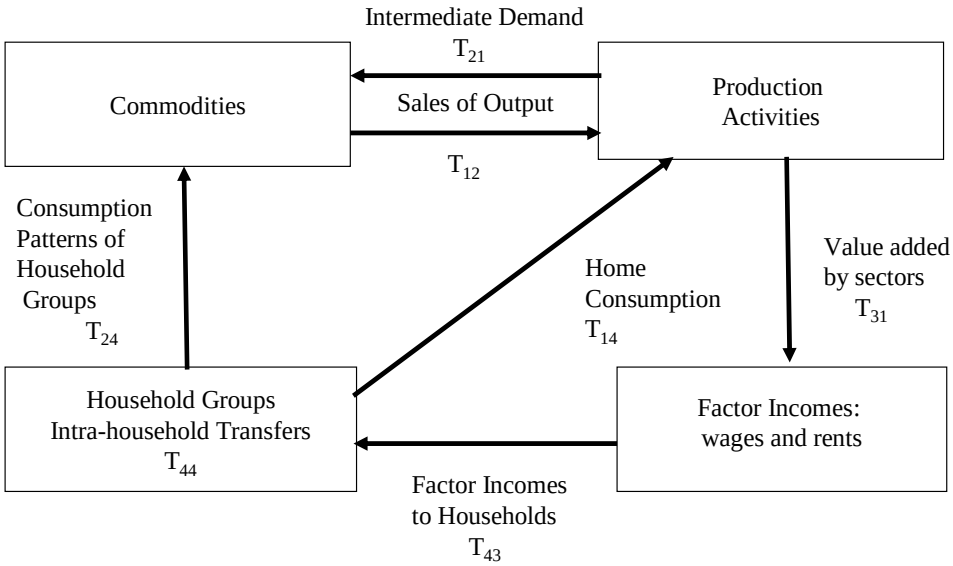
3.1.3. SAM as a Conceptual Framework

The SAM framework can be used as a conceptual tool to explore the impact of exogenous changes in variables, such as exports from the region, government expenditures, and a variety of investments on the socio-economic system and the resulting structure of production, factorial, and HH income distributions. In this sense, SAM becomes the basis for simple multiplier analysis and calibration of CGE models (Pyatt and Round 1979; Dervis, de Melo, and Robinson 1982). The first question to address when using SAM as a conceptual framework is to which accounts are considered exogenous and which are endogenous. Sadoulet and de Janvry (1995) define endogenous accounts as those for which changes in the level of expenditure directly follow any changes in income, while exogenous accounts are those for which we assumed that expenditures are set independently of income. It has been customary to consider the government, the RoW, and the savings-investment accounts as exogenous, and activities, commodities, factors, and HHs as endogenous.[5] To illustrate how the SAM approach is helpful in deriving the changes in income distribution and expenditure patterns by socio-economic groups resulting from a change in the structure of production due to exogenous shocks, Figure 1 presents the relationship among the endogenous SAM accounts. These transformations incorporate the mechanisms that translate value added from production into income of different types of HHs, via ownership of factors of production.

[5]An endogenous capital account would reflect some kind of internal flexibility of capital flows, while an endogenous RoW assumes that trade is relatively free between the region and outside areas.

There are three key transformations to consider. First, in addition to the intermediate demand of input by the activities, transactions T_{21}, the level and the structure of output by different activities generate the aggregate demand for factors (labor, land, and capital), which brings employment linkages into the analysis. The stream of value added from the production side rewards the factors of production, with wages going to different types of labor, and rents going to land and capital. This is depicted in transactions T_3.

Figure 1. Relationships Among Endogenous Accounts



Source: Adapted from Thorbecke 1998
Note: The direction of the arrows indicates payments between accounts. The first number in the subscription of T (transaction) indicates the account that receives payment and the second number indicates the account that makes the payment. The account numbering is : 1 = activities; 2 = commodities; 3 = factors of production; and 4 = HHs.

Second, the transformation from factorial distribution to the distribution of income across HH groups (transaction T_{43}) depends on which groups own which factors. For example, wage payment to hired labor goes to HHs that provide this type of labor; that can be both in agricultural or non-agricultural sectors. Likewise, rental income accrues to the owners of capital, land, and other natural resources. Family labor is rewarded at shadow wages. Resource endowment, particularly land and human capital, is important at several levels. Landless HHs can be affected quite differently by development policy than smallholders and large farmers (Thorbecke 1998).[6] Likewise, the better educated tend to be able to get jobs in better rewarded, more formal and organized sectors, while the less educated are limited to employment opportunities largely in traditional agriculture and manual jobs off-farm. Nevertheless, given the current level of technological development in Mozambique, even the effects of employment linkages in those low technology sectors are likely to be important if

[6] Although landlessness, as such, does not appear to be a serious problem in Mozambique, there is a strong positive relationship between access to land and smallholder welfare.

policy is successful in generating increased rural output growth. It is worth noting that in the study region part of the hired labor force originates from Malawi, resulting in part of the labor payments leaking outside the region. The design of the SAM and the CGE model attempts to account for that.

The third transformation in Figure 1 (transaction T_{24}) yields the consumption patterns of the different HH groups as they spend their additional income. It reveals the value of commodities/services purchased and consumed by those groups, providing crucial information on their living standards, and providing indications of likely induced effects and the potential to strengthen growth through consumption linkages, especially when they spend increasing shares of their income on locally produced goods.

Once SAM is balanced, with all the analytically relevant disaggregation of selected endogenous accounts, it can be used to simulate the effects on the income of the endogenous accounts of shocks in the exogenous accounts: government, savings-investment, or RoW. This can be done using either fixed price models (multiplier analysis) or CGE models; the latter allow for shocks in model parameters, such as tax rates, prices, sector productivities, and others. Appendix A details the SAM multiplier model.

The SAM multiplier model is limited in several ways. First, it assumes that all the endogenous sectors have unlimited capacity to supply goods and services, i.e., an infinitely elastic supply: a Keynesian demand-driven system without resource constrains (Sadoulet and de Janvry 1995; Taylor and Adelman 1996).[7] Second, prices are assumed fixed. This may be a reasonable assumption when the costs of trade with outside markets are low and the region is likely to be a price taker for most goods and factors. However, high costs for participation in those outside markets and imperfect substitutability between family and hired factors (e.g., labor) may result in endogenous prices for a number of regional goods and factors in Mozambique. Third, SAM multiplier models assume that production uses fixed proportions technologies (constant marginal productivity of factor input) and that average and marginal expenditure propensities are the same. Relaxing the assumption of linearity in production requires the use of CGE models, discussed in the next section.

3.2. The ZVR-CGE Model

3.2.1. Introduction

The ZVR-CGE model used in this paper is based on the IFPRI standard model of Lofgen, Harris, and Robinson (2002). The standard CGE model accounts for all payments recorded in SAM. The calibration of the model, therefore, follows the SAM disaggregation of activities, commodities, factors, and HHs previously described. All the relevant features introduced in SAM to reflect the local economy and the issues at hand are mirrored in the CGE.

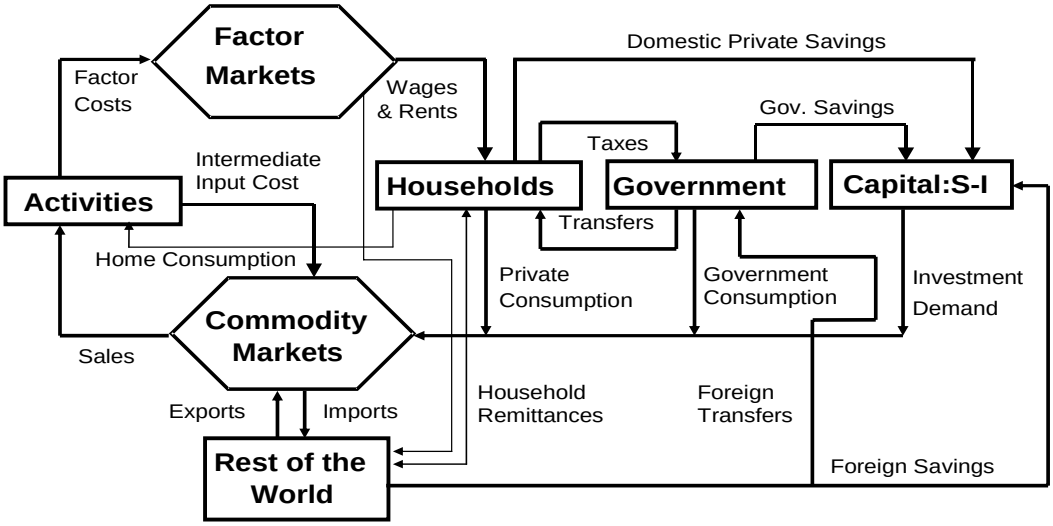
The model is written as a set of simultaneous equations, most of which are non-linear. First order optimality conditions capture the behavior of producers and consumers assumed to maximize profits and utility, respectively. Other equations include a set of constraints that have to be satisfied by the system as a whole, but are not necessarily considered by any individual actor. Such constraints cover markets for products and factors, and macro

[7] Appendix A presents an idea about some modifications to the model that allow us to deal with this limitation.

aggregates, i.e., savings-investment balance (SI-B), government budget, and the balance of the current account of the RoW.

Figure 2 presents a stylized structure of the model, indicating the flows between various SAM accounts. This sections outlines the standard model structure, and adds some considerations with respect to interlinked transactions and sector expansion, and HH typology and poverty analysis within the CGE framework.

Figure 2. Stylized Regional Model Structure



Source: Adapted from Lofgren *et al.* (2002)

Source: Adapted from Lofgren, Harris, and Robinson 2002

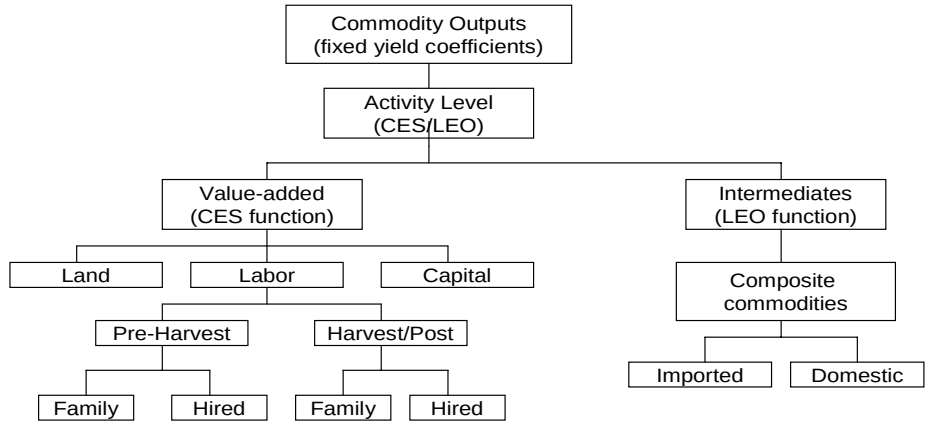
The description of a CGE model structure is done by specifying the agents and their behavior, the rules that bring the different markets to equilibrium (Sadoulet and de Janvry 1995), and closures to system constraints. For the regional ZVR-CGE, we specified (a) activities, production, and factor markets; (b) institutions: HHs, government, and the RoW; (c) commodity markets; (d) macro closure rules for system constraints; and (e) model calibration. This section draws mostly on Lofgren, Harris, and Robinson (2002). We focused on the essential elements of the standard model and highlight features relevant for the regional model. In specifying the model structure, it is important to keep in mind the different sets and sub-sets of the SAM accounts. Considerations on choice of functional forms and tradability of commodities are sometimes differentiated across the different account sets.

3.2.2. Activities, Production, and Factor Market Closures (FMCs)

Each activity represents a producer that is assumed to maximize profits, i.e., the difference between revenues earned and the cost of intermediary input and payments to factors. Profits are maximized subject to a production technology that follows the structure represented in Figure 3. The top of the technology nest contains a Leontief (LEO) function of the quantities

of aggregated factor value-added and aggregate intermediate input.[8] Value-added is defined as a constant elasticity of substitution (CES) of primary factors, and the aggregate intermediary input is a LEO function of disaggregated intermediate input that can be domestically produced or imported. Figure 4 illustrates the elasticity of substitution between factors and/or intermediates.

Figure 3. Structure of Production Technology



Note: CES – Constant Elasticity of Substitution Function LEO – Leontief Function

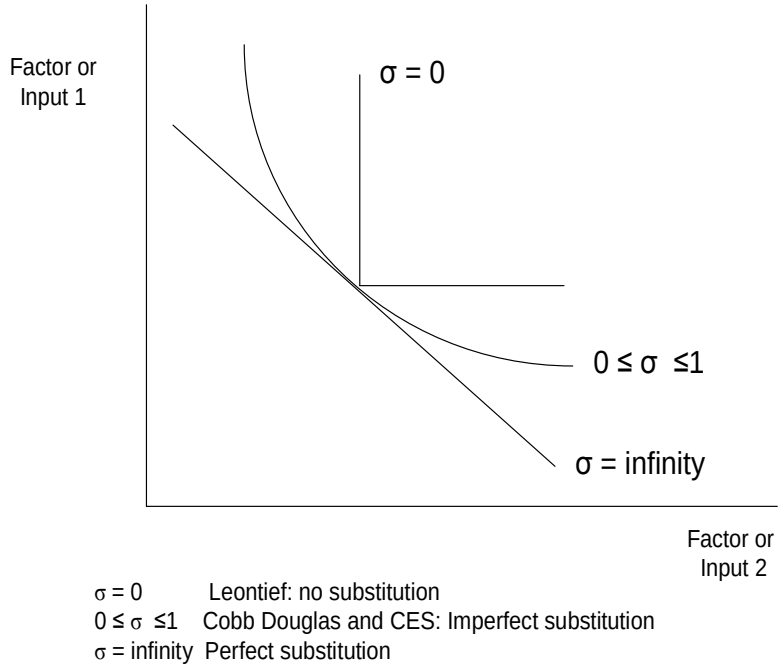
Source: Adapted by author from Lofgren, Harris, and Robinson 2002

Each activity produces one or more commodities according to fixed yield coefficients, e.g., a tobacco farming activity produces tobacco, maize, and other food crops. Likewise, a commodity may be produced by more than one activity, e.g., tobacco is produced by MLT and DIMON-Mozambique tobacco farms, and maize is produced by all agricultural activities.[9]

As profit maximizing agents, producers choose their levels of production and input use on the basis of prices in product and factor markets—each activity uses a set of factors up to the point where the marginal value product of each factor is equal to its wage or rent. Factor wages/rents may differ across activities when markets are segmented or even for mobile factors, when discrepancies emerge as a result of sector specific determinants.

[8] We used the LEO alternative as the default for all activities. It should be noted, however, that a CES alternative at the top of the technology nest may be preferable for particular sectors if evidence supports the idea that available techniques allow for the variation in the aggregate mix of value-added and intermediate inputs.
[9] HH survey data were used to compute the structure of crop production for the agricultural activities. The data also provided the information needed for HH non-farm activities represented in SAM. As explained earlier, the HH groups defined in SAM were defined on the basis of information from the survey data and the structure of activities.

Figure 4. Elasticities of Substitution



Source: Author

The standard model offers alternative FMCs, i.e., mechanisms for equilibrating supply and demand in specific factor markets (land, labor, or capital). A description of each available FMC follows and is summarized in Table 4.

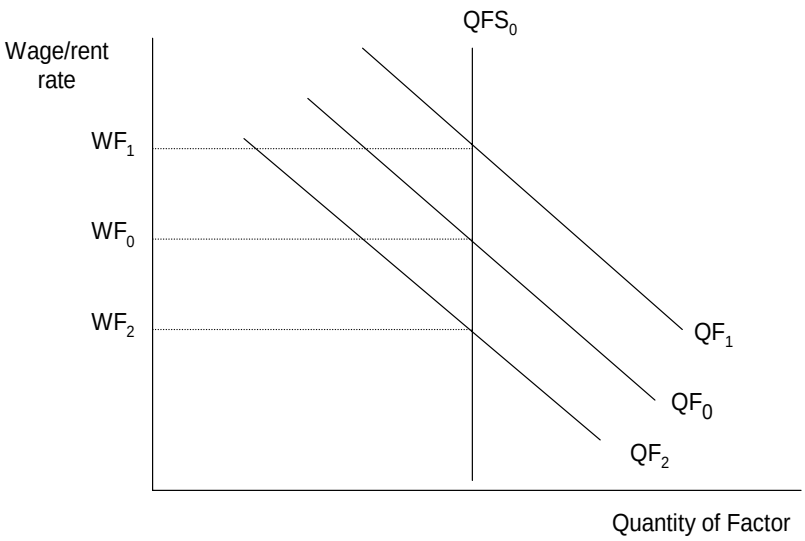
Table 4. Alternative FMCs

Variables		FMCs					
		Full Employment (Neoclassical) (FMOBFE)		Unemployment (FMOBUE)		Factor Market Segmentation (FACTFE)	
Variable	Description	FXD	FLX	FXD	FLX	FXD	FLX
QFS(F)	Quantity supplied of factor F	●			●		●
QFD (F, A)	Quantity demanded of factor F by activity A		●		●	●	
WF (F)	Economy-wide wage/rent for factor F		●	●		●	
WFDIST (F, A)	Activity-specific wage distortion for factor F	●		●			●

Source: Author
Notes: FXD–Factor is fixed; FLX–Factor is flexible; F–Factor; A–Activities; FACTFE–Factor is activity specific and fully employed; FMOBFE–Factor is mobile and fully employed; FMOBUE–Factor is mobile and unemployed

The first factor closure is the *FMOBFE*. The default closure is to fix the supply of the factor at the observed base level, and allow variation in an economy-wide factor price variable, e.g., land rental rate, wage rate, or rate of return to capital.[10] This ensures that the sum of demands from all activities equals the total quantity supplied in the system (full employment). Under this closure, factors are mobile between the demanding activities. Each activity pays an activity-specific wage that is the product between the endogenously determined economy-wide wage and an exogenous activity-specific wage distortion term that is fixed in this closure. This is also called the neoclassical closure. Figure 5 illustrates this closure.

Figure 5. Full Employment of Factors Perfectly Inelastic Supply



QFS – Quantity of factor supply
QF – Quantity of factor demand
WF – Wage/rent (price of factor)

Source: Author

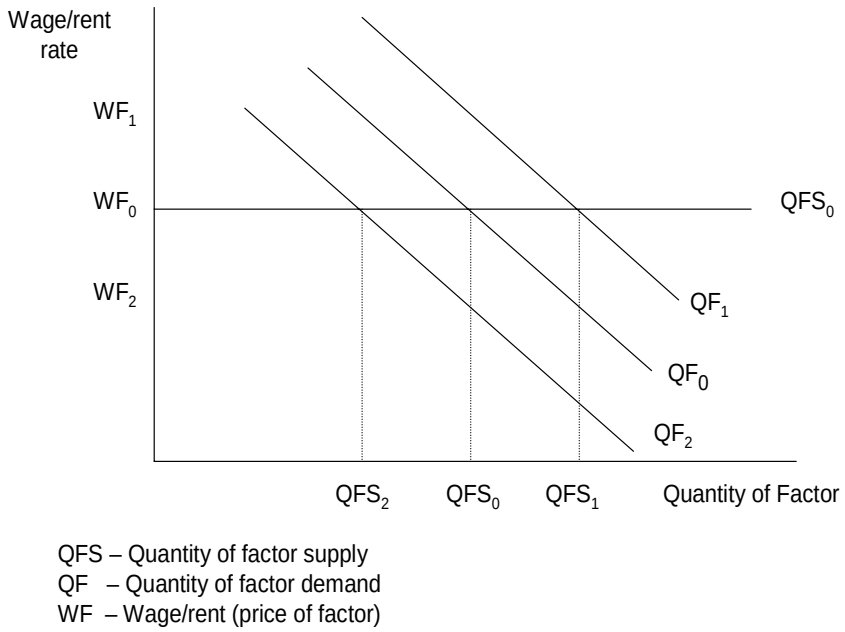
A second closure rule is the *FMOBUE*. This assumes that a factor is unemployed and the real wage/rent is fixed. In this closure, the economy-wide variable is fixed (exogenized) and the supply variable is endogenized. Each activity is free to hire any desired quantity of the factor at its fixed activity-specific wage. In essence, the supply variable merely records the total quantity demanded. This closure is graphically represented in Figure 6.

The *FACTFE* is a third closure rule. Under this closure, the factor market is assumed to be segmented and each activity is forced to employ the observed base year quantity, i.e., the factor is activity specific. More generally, it is appropriate when there are significant quality differences (or activity specificity) between units of a factor used in different activities (Lofgren, Harris, and Robinson 2002). In this closure, the quantity of activity-specific factor

[10] This economy-wide factor price variable is not specific to each activity. It is an aggregate variable used to balance aggregate supply and aggregate demand of each factor. Each activity is assumed to have a price distortion factor that will influence the activity specific factor price.

demands and the economy-wide wage are fixed while the activity specific wage terms and the supply variables are flexible.

Figure 6. Unemployment of Factors Perfectly Elastic Supply



Source: Author

3.2.3. HHs, Government, and RoW

The institutional block of the standard regional CGE model describes the behavior of HH groups, government, and the RoW. *HHs* choose the levels of consumption that maximize their utility on the basis of disposable income and prices. HH consumption covers marketed commodities, purchased at market prices, and home consumed commodities valued at their opportunity cost, the activity specific producer prices.[11] This feature accounts for the simultaneous decision making process of HHs as producers and consumers of certain commodities. That and the use of activity specific producer prices for home commodities and market prices for purchased commodities implicitly addresses the non-recursive nature of the HH decision making process in this model. HH consumption behavior of market and home commodities is modeled according to Linear Expenditure System (LES) demand functions, derived from maximization of a Stone-Geary utility function subject to a consumption expenditure constraint.[12]

[11] The standard SAM only disaggregates home consumption by activity and HH, not by commodity, activity, and HH. In the regional SAM, HHs consume from activities that produce multiple outputs. To accommodate that, non-SAM data are needed to allocate home consumption across the commodities produced by each relevant multiple-output activity. Shares of home consumption of HH farm outputs are derived from survey data for each agricultural, fishing, and livestock activity.

[12] This utility function is a generalization of the Cobb-Douglas function and incorporates the idea that certain minimum amounts of each good must be bought.

$$\text{Max U} = \sum_{c=1}^{n} \beta_c \ln\left(q_c - q_c^0\right) \tag{1}$$

$$\text{Subject to} \quad \sum_{c=1}^{n} p_c q_c^0 + \sum_{c=1}^{n} p_c\left(q_c - q_c^0\right) = E$$

$$\text{With} \quad q_c \geq q_c^0$$

$$0 < \beta_c < 1$$

$$\sum_{c=1}^{n} \beta_c = 1$$

Where, q_c is the quantity of consumption of commodity c, q_c^0 is the subsistence or minimal amount of the consumption of commodity c that must be bought by the HH, β_c is the marginal share of consumption of commodity c, p_c is the price of commodity c, and E is the total HH consumption expenditure.

The first-order condition results in a LES which can be written as:

$$p_c q_c = p_c q_c^0 + \beta_c\left(E - \sum_{c=1}^{n} p_c q_c^0\right) \tag{2}$$

This system can be interpreted as stating that expenditure on good c, given as $p_c q_c$, can be decomposed in two components. The first is the expenditure on a "base amount" q_c^0 of good c, which is the minimum expenditure for which the consumer is committed. The second is a fraction β_c of the *supernumerary income*, defined as the income above the "subsistence income," $\sum_{c=1}^{n} p_c q_c^0$, needed to purchase base amount of all goods (Intriligator, Bodkin, and Hsiao 1996). These two components correspond, respectively, to committed and discretionary expenditure on commodity c.

Since HH consumption for the various groups in SAM (h) is for two types of commodities, from the market and from home production, we have a two-component LES system, each with a structure similar to equation (2):

<u>Consumption of marketed commodities</u>

$$p_c^m q_{ch}^m = p_c^m q_{ch}^{0m} + \beta_{ch}^m\left(E_h - \sum_{c' \in C} p_{c'}^m q_{c'h}^{0m} - \sum_{a \in A} \sum_{c' \in C} p_{ac'}^{0h} q_{ac'h}^{0h}\right) \tag{3}$$

<u>Consumption of home production</u>

$$p_{ac}^h q_{ach}^h = p_{ac}^h q_{ach}^{0h} + \beta_{ach}^h\left(E_h - \sum_{c' \in C} p_{c'}^m q_{c'h}^{0m} - \sum_{a \in A} \sum_{c' \in C} p_{ac'}^{0h} q_{ac'h}^{0h}\right) \tag{4}$$

where,

E_h HH consumption expenditures

q_{ch}^{m} quantity of consumption of marketed commodity c for HH h

q_{ach}^{h} quantity of home consumption of commodity c from activity a for HH h

$\mathrm{p}_{\mathrm{c}}^{\mathrm{m}}$ market price of commodity c

$\mathrm{p}_{\mathrm{ac}}^{\mathrm{h}}$ producer price of commodity c for activity a

β_{ch}^{m} subsistence consumption of marketed commodity c for HH h

$q_{\mathrm{ach}}^{\mathrm{0h}}$ subsistence consumption of home commodity c from activity a for HH h

β_{ch}^{m} marginal share of consumption spending on market commodity c for HH h

β_{ach}^{h} marginal share of consumption spending on home commodity c from activity a for HH type h

Demand functions are derived by dividing both sides of each equation by the relevant price.

Government collects taxes and receives transfers from other institutions. The standard model includes variables that account for direct taxes from institutions and factors, value added and activities, import tariffs, export taxes, sales taxes, government factor incomes, and transfers from the RoW. In our regional SAM, representing a base situation and reflecting conditions on the ground, the regional government does not collect taxes on activities or domestic and foreign trade. We only accounted for the collection of IRN (Imposto de Reconstrução Nacional) on a per head basis in rural communities, and substantial financing from the central government and other institutions in the RoW.[13] The government uses that income to buy goods and services (e.g., health and education) and transfer to other institutions (pensions to HHs). Government consumption is fixed in real terms and transfers are consumer price indexed. Government savings (surplus/deficit) is a flexible residual in the model; more details are in section 3.2.5 on macro closures.

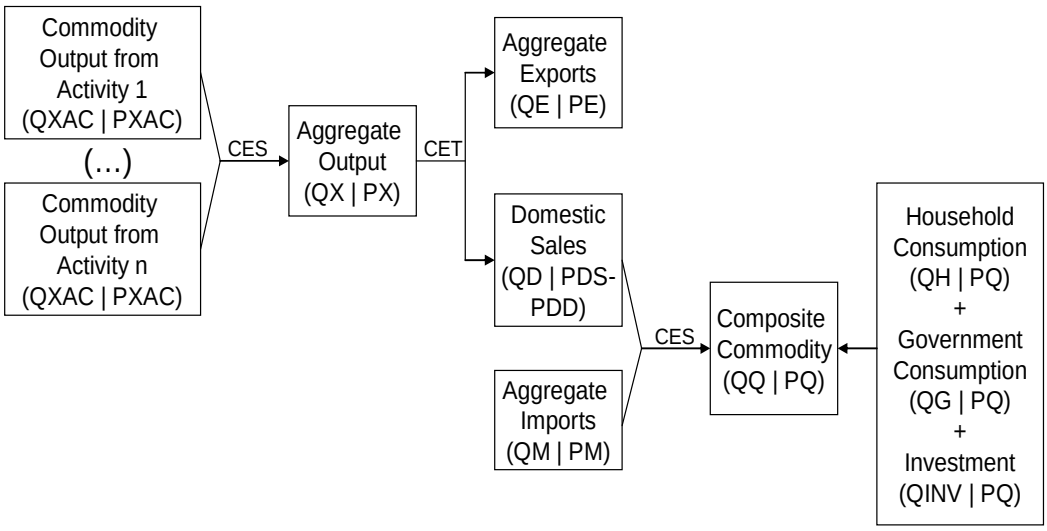
The *RoW* records transactions between domestic actors and the RoW, including imports, exports, and transfers. Commodity trade with the RoW is discussed in section 3.2.4. Transfer payments between the RoW and domestic institutions and factors are fixed in foreign currency. Foreign savings, i.e., the current account deficit, is the difference between foreign currency spending and receipts.

3.2.4. Commodity Markets

All commodities, except home consumed output, enter markets. Figure 7 shows the physical flow for marketed commodities with the indication of quantity and price variables relevant in each case.

[13] In the policy simulations, however, the model allows us to introduce alternative fiscal and quantitative trade policy measures.

Figure 7. Flows and Specification of Aggregation of Marketed Commodities



Note: CES – Constant Elasticity of Substitution CET – Constant Elasticity of Transformation
Source: Lofgren *et al.* (2002)

Source: Lofgren, Harris, and Robinson 2002

For marketed output, the first stage is the aggregation of each commodity produced by different activities. As a result of differences in timing, location, and quality between different activities, these outputs are imperfectly substitutable. Therefore, commodity aggregation is done using a CES function.

$$QX_c = \alpha_c^{ac}\left(\sum_{a\in A}\delta_{ac}^{ac}QXAC_{ac}^{-\rho_c^{ac}}\right)^{-\frac{1}{\rho_c^{ac}-1}} \qquad c \in CX \qquad (5)$$

where

CX	set of domestically produced commodities
QX_c	aggregate market production of commodity c
$QXAC_{ac}$	market output quantity of commodity c from activity a
α_c^{ac}	shift parameter for domestic commodity aggregation function
δ_{ac}^{ac}	share parameter for domestic commodity aggregation function
ρ_c^{ac}	domestic commodity function exponent

Activity specific output is derived from the problem of minimizing the cost of supplying a given quantity of aggregated output subject to equation (5). As shown in equation (6), the optimal quantity of the commodity from each activity source (QXAC) is found at the point where marginal cost of the commodity from that activity equals its marginal revenue product. The activity specific quantity is inversely related to the activity-specific price (PXAC).

$$PXAC_{ac} = PX_c QX_c \left(\sum_{a \in A} \delta_{ac}^{ac} QXAC_{ac}^{-\rho_c^{ac}} \right)^{-1} \delta_{ac}^{ac} QXAC_{ac}^{-\rho_c^{ac}-1} \quad \text{a} \in \text{A}, \ \text{c} \in \text{CX} \qquad (6)$$

where

$PXAC_{ac}$ producer price of commodity c for activity a

PX_c aggregate producer price for commodity c

The choice between commodities from different activities is cast as an optimization problem. Equation (6) is the first-order condition determining profit maximization from selling the aggregate output, QX_c, at the price, PX_c, subject to the aggregation function and disaggregated, activity specific, commodity prices. For commodities with a single producer, the value of the share parameter δ_{ac}^{ac} is unity and as a result $QXAC_{ac} = QX_c$ and $PXAC_{ac} = PX_c$.

This aggregated domestic output (QX) is then, in the second stage, allocated to exports (QE) and domestic sales (QD). It is assumed that suppliers seek to maximize sales revenue for any given aggregate output level, subject to imperfect transformability between exports and domestic sales expressed by a Constant-Elasticity-of-Transformation (CET) function.[14] For all commodities with output, we have

$$PX_c QX_c = PDS_c QD_c + PE_c QE_c \qquad \text{c} \in \text{CX} \qquad (7)$$

For commodities with both domestic sales (set CD) and exports (set CE),[15] such as maize, groundnuts, potatoes, goats, etc, the CET function is given by

$$QX_c = \alpha_c^t \left(\delta_c^t QE_c^{\rho_c^t} + \left(1 - \delta_c^t\right) QD_c^{\rho_c^t} \right)^{\frac{1}{\rho_c^t}} \qquad c \in \left(CE \cap CD\right) \qquad (8)$$

First-order conditions for maximization of producer revenues given the two prices (PDS and PE) subject to the CET function and fixed quantity of domestic output QX, indicates that the optimal mix between exports and domestic sales is defined by the Export-Domestic Supply Ratio

$$\frac{QE_c}{QD_c} = \left(\frac{PE_c}{PDS_c} \cdot \frac{1 - \delta_c^t}{\delta_c^t} \right)^{\frac{1}{\rho_c^t - 1}} \qquad c \in \left(CE \cap CD\right) \qquad (9)$$

Equation (9) indicates that an increase in the export-domestic price ratio generates an increase in the export-domestic supply ratio, i.e., a shift toward the destination that offers the higher return.

For domestically sold output without exports and for exports without domestic sales, the output transformation is given by

$$QX_c = QD_c + QE_c \qquad c \in \left(CD \cap CEN\right) \cup \left(CE \cap CDN\right) \qquad (10)$$

[14] Following the small country assumption, export demands are infinitely elastic at given world prices. The supply price for domestic sales is equal to the price paid by domestic demanders.

[15] The set of domestic commodities without domestic sales is referred to as CDN, and the set on non exported commodities as CEN.

This equation allocates the entire output volume to one of these two destinations. In the Zambezi Valley regional model, there are a number of commodities that are exclusively sold in the domestic market. For instance, all the raw tobacco and cotton produced by farming HHs are sold domestically to trading-exporting CF firms that add value and export it packed to the RoW. The two commodities are clearly differentiated. While the raw tobacco and cotton are all sold domestically, the packed tobacco and cotton are all exported; there is no transformability between domestic consumption and exports for these commodities. See Table 5 for commodity tradability position in the Zambezi Valley economy.

Domestic sales (QD) and aggregate imports (QM) make up the composite supply in domestic markets (QQ). Absorption, i.e., the total domestic spending on domestic output and imports at domestic demander prices (net of sales tax, but inclusive of cost of trading input), is defined as

$$PQ_c QQ_c = PDD_c QD_c + PM_c QM_c \qquad c \in (CD \cup CM) \qquad (11)$$

In the standard model, the demand for these commodities is derived under the assumption that domestic demanders minimize costs subject to imperfect substitutability, captured by a CES aggregation function, also referred to as the Armington function.

$$QQ_c = \alpha_c^q \left(\delta_c^q QM^{-\rho_c^q} + \left(1 - \delta_c^q\right) QD_c^{-\rho_c^q} \right)^{-\frac{1}{\rho_c^q}} \qquad c \in (CD \cap CM) \qquad (12)$$

The domain of the CES function is limited to commodities that are both imported and domestically produced. The optimal mix between imports and domestic output is defined by

$$\frac{QM_c}{QD_c} = \left(\frac{PDD_c}{PM_c} . \frac{\delta_c^q}{1 - \delta_c^q} \right)^{\frac{1}{1+\rho_c^q}} \qquad c \in (CD \cap CM) \qquad (13)$$

Equations (11) through (13) define the first-order conditions for cost minimization given the two prices (PDD and PM) and subject to the Armington function and a fixed quantity of the composite commodity (QQ). Equation (13) ensures that an increase in the domestic-import price ratio causes an increase in the import-domestic demand ratio, i.e., a shift away from the relatively more expensive source.

The composite commodity (QQ) is demanded in the domestic market in the form of HH consumption (QH); government consumption (QG); investment (QINV); intermediary input use (QINT); and demand for transaction input (QT):

$$QQ_c = \sum_{a \in A} QINT_{ca} + \sum_{h \in H} QH_{ch} + QG_c + QINV_c + QT_c \qquad c \in C \qquad (14)$$

Table 5. Tradability of SAM Commodities in the Zambezi Valley

Commodities Set (c)	Exported Commodities: Domestic Sales Set (CD) $c \in CD$	Imports Set (CM) $c \in CM$	Exports Set (CE) $c \in CE$	Commodities Set (c) (continuation)	Imported Commodities: Domestic Sales Set (CD) $c \in CD$	Imports Set (CM) $c \in CM$	Exports Set (CE) $c \in CE$
Raw cotton	•			Sugar/salt		•	
Packed cotton			•	Tea/coffee		•	
Raw tobacco	•			Ready-to-eat foods	•		
Packed tobacco			•	Alcoholic beverages	•		•
Maize grain	•		•	Education/health	•		
Rice	•	•		Trading services	•		
Maize meal	•			Housing and utilities	•		
Bread/flours	•			Seeds		•	
Beans	•	•		Pesticides/fertilizers		•	
Groundnuts/roots	•		•	Other agro-inputs		•	
Vegetables	•		•	Firewood and charcoal	•		
Fruits	•	•		Fuel		•	
Coconuts		•		Wood/grass/cane	•		
Meat – cow	•	•		Textile/footwear	•	•	
Meat – goat	•		•	Metal/blacksmithing	•	•	
Meat – pork	•			Kitchen utensils	•		
Meat – birds	•		•	Soap and hygiene		•	
Fish/milk/eggs	•			Imported drink/tobacco		•	
Cooking oil		•		Other commodities	•		•

Source: ZVR-SAM

3.2.5. Macro System Closures

The model allows for alternative closure rules for three macro balances: the current government account (GOV-B), the SI-B, and the current account of the balance of payments that includes the trade balance with the RoW (RoW-B). Table 6 presents the alternative closure rules for each of the macro balances and indicates default and alternatives chosen for the regional economy model.

The default closures in the regional model are chosen to best resemble the circumstances in the regional economy. The closure for the government balance assumes that all taxes, and the real government consumption are fixed and the government savings (the difference between its current revenues and expenditures) is a flexible (endogenous) residual. Although it is an available option, given the limited role and discretion of the local government in this model, we do not consider alternative closures where tax rates and government real consumption are endogenously determined.

For the external balance, the standard model applied to national economies normally assumes fixed foreign savings with flexible exchange rate. This particular closure implies that, if, *ceteris paribus*, foreign savings are below the exogenous level, a depreciation of the real exchange rate would correct the imbalance by reducing spending on imports and increasing earnings from exports. In sub-national models, the treatment given to the RoW-B depends on the structure of "foreign" trade and flows. For regional economies that trade exclusively with the rest of the country (domestic RoW), the exchange rate is assumed fixed at the one-to-one rate (fixed real exchange rate indexed to the model numeraire) and foreign savings (and the trade balance) are allowed to vary. In our model, however, given the evidence of massive trade between the region and the foreign RoW added to the massive use of foreign currency in those transactions, it is reasonable to account for a flexible exchange rate regime closure rule.[16] We, therefore, use the default of a flexible exchange rate and fixed foreign savings, but also test the alternative of fixed exchange rate and flexible foreign savings.

For the SI-B, closures can be either investment driven (the value of savings adjusts to pre-defined investment levels) or savings driven (the value of investment simply adjusts to existing savings). We assumed a savings driven closure, under which investment is determined from available savings from HHs and the local government. This implies that investment is endogenous and self-financed by the region. This is a reasonable assumption, given the missing and incomplete credit markets in rural Mozambique (Benfica 2003). The alternative closure (investment driven savings) implicitly assumes that the government is capable of implementing policies that generate the necessary private savings to finance fixed real investment levels. Given the limited government modeling sophistication in the model, and under the current circumstances in the regional economy, this is not a realistic closure.

[16] Given the extremely poor road and communications infra-structure in the region, most of the imports into the region originate from Malawi. For the same reason, many of the identified exports, including maize, potatoes, tobacco, and others are directed into Malawi, and a great deal of imports originate from that country. Factor payments to the RoW are also predominantly to Malawian migrant labor.

Table 6. Macro System Closures in the ZVR-CGE Model

Macro Balances and Available Closures		Default and Alternative Closures in the Regional Model	
Macro Balances	Definition of Available Closures	Default Closure	Alternative Closures
Government Balance (GOV-B)	GOV savings are flexible, direct tax rates are fixed	●	
	GOV savings are fixed, uniform direct tax rate point change for selected institutions		●
	GOV savings are fixed, scaled direct tax rate for selected institutions		●
SI-B	Investment driven savings (savings adjust to given level of investment) - uniform mps rate point change for selected institutions		●
	Investment driven savings (savings adjust to given level of investment) - scaled mps for selected institutions		●
	Savings driven investment (investment level defined as a function of existing savings in the economy)	●	
	Investment is fixed absorption share – uniform mps rate point change		●
	Investment is fixed absorption - scaled mps		●
RoW Balance (RoW-B)	Flexible exchange rate and fixed foreign savings	●	
	Fixed exchange rate and flexible foreign savings		●[a]

Source: Author
[a] Alternative macro closures tested in our experiments

3.2.6. Model Benchmark Calibration

The benchmark of a CGE model is a solution of the model that replicates the observed economic data for the base year compiled in SAM. SAM records in its entries nominal values of transactions in the base year. The first step is to choose measurement units for all factors so that all factor prices are initially equal to one. Likewise, one chooses measurement units for the domestic commodities, imports, and exports so that the prices of domestic goods and imports, the world price of exports, and the exchange rate are all set equal to one in the base year. This normalization allows all initial quantities and prices to be computed, and parameters, including those for the production and utility functions that are directly computed from the shares to be derived (Sadoulet and de Janvry 1995). The shares matrix provides the starting point for estimating parameters of non-linear, neoclassical production functions, factor demand functions, and HH expenditure systems in the CGE model. Results in section 4 present a great deal of outputs that illustrate base year factor, intermediary input, and market and HH expenditure shares derived from SAM.

In addition to the shares provided by SAM, the calibration of the CGE model requires that one defines three sets of elasticities: production, trade, and consumption. Table 7 lists and defines the different elasticities within each set.

Table 7. Elasticity Sets and Definitions

Elasticity Sets	Elasticities	Definition
Production	Output aggregation	Output aggregation elasticity for commodity c
	Factor-factor substitution	Elasticity of substitution between factors
	Factor-intermediate substitution	Elasticity of substitution between aggregate factor and intermediate
Trade	Armington elasticity	Elasticity of substitution between imports and domestic output in domestic demand
	Constant elasticity of transformation (CET) elasticity	Elasticity of transformation between exports and domestic supplies in domestic marketed output
HH Consumption	Frisch parameter for HH LES demand	Elasticity of the marginal utility of income with respect to income
	Expenditure elasticity – market demand	Expenditure elasticity of market demand for commodity c by HH h
	Expenditure elasticity – home demand	Expenditure elasticity of home demand from activity a for commodity c by HH h
	Commodity value share of home consumption	Value share for commodity c in home consumption of HH h from activity a

Source: Author

The actual elasticity parameters used in the model were obtained thorough derivations from survey data and from the country data available from the GTAP (Global Trade Analysis Project) database.

The CGE model is homogeneous in all prices. A numeraire is chosen by fixing an aggregate price equal to one. The weight of such an aggregate price can be the initial values of production in each sector. Commodity prices, wages, and exchange rates are, therefore, interpreted in real terms.

3.3. Interlinked Transactions and Expansion Paths

All raw cotton and tobacco production generated by smallholder growers in the Zambezi Valley region originate from CF arrangements organized by four agro-industrial firms. Those firms are assigned to specific geographical concession areas, where they provide input and extension assistance to small farmers on credit, and are granted monopsony rights that entitle them to purchase all the output at predetermined prices. Given the failure in both input and output markets, the interlinked arrangements imply that firms have a monopoly in input markets and a monopsony in product markets. Given the lack of a wide range of alternative sources of cash income, this type of arrangement is extremely important for rural HHs in the region.

In the process of expanding their CF operations, firms—that have limited resources—will choose between alternative paths to do so. Essentially, they have the option to support relatively less farmers each receiving substantial level of support (larger loans) and, therefore, planting larger areas with the crop, or a relatively larger number of farmers each receiving smaller loans and, therefore, planting relatively smaller areas with the crop.[17] While this is an

[17]Looking at the lenders' point of view, Gangopadhyay and Sengupta (1987) prove that a capital constrained lender interested in maintaining the level of benefits of a previously less constrained environment will sign a smaller number of contracts with loans equal to or larger than the ones provided under a less constrained situation. It can be argued, however, that given the concavity of the farmers' production functions, it may be

important issue, the choices faced to decide which path is more appropriate depend on many factors that fall outside the scope of this study.

In this paper, we assumed that the CF operations represented in the region expand the size of their operations with the same factorial structure represented in the base scenario. As described later in this paper, expansion is combined with a series of other shocks. We were ultimately interested in assessing the income and poverty effects of those shocks on the different HH groups.

3.4. RHs and Poverty Analysis in a CGE Framework

3.4.1. Introduction

This section discusses a framework for the analysis of the impact of economic shocks on poverty of HH groups in a computable general equilibrium (CGE) framework. The CGE model described in section 3.2 incorporates information on how RH groups earn and spend their income. That sort of information, including the rules governing factor markets, and HH heterogeneity with respect to factor endowments, demographic composition, consumption patterns, and market access, is important to assess the impact of exogenous shocks. Lofgren, Robinson, and El-Said (2003) point out three features necessary for such a framework. First, it must include shocks that are of interest regarding their potential differential impact on HH groups. Second, it should be able to capture the impact of shocks on the extended functional distribution of income, the distribution of income across disaggregated factors that remunerate the HH groups on the basis of ownership. Finally, it must map from this extended distribution across factors to HH income with enough detail to generate information about the size distribution needed to capture poverty and inequality measures.

Approaches to undertake poverty analysis in a general equilibrium framework can be aggregated into two major categories: micro-simulation (MS) and RH approaches. Each category has many variants.[18] The essence of the MS approach is to model the behavior of the individual agents, HHs and/or firms, using a micro-database linked to the standard CGE model through an integrated CGE/MS model or, in a sequential fashion, with the CGE model feeding the MS model with price, income, and employment data. Under the RH approach, a separate module generates, for each simulation, results for individual HH income/expenditure by drawing on a distribution function with known parameters and known RH income, or individual survey observations scaled using simulated changes in RH income from the CGE model post-simulation results. Then, the results are used to perform standard poverty and inequality analysis. Such analysis may include, but is not limited to, poverty measures such as the F-G-T P_α class of indicators (poverty headcount, depth, and severity of poverty) and stochastic dominance analysis, and various inequality measures. In this study, given the nature of the available data and the implied operational feasibility, we used the RH approach. This approach is now detailed and the essential rationale and definitions for the stochastic dominance analysis used in this study.

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better for the lender to sign a greater number of contracts with smaller loans provided to each farmer. This depends, obviously, on the stage of production where farmers are operating.

[18] It should be noted that no single approach dominates and the choice is predominantly dependent upon informational demands and operational constraints that vary across applications.

3.4.2. The RH Approach

The CGE models have a flexible number of RHs. Our ZVR-CGE model divides the HHs in two groups in each area, based on their diversification into cash cropping under contract. The RH approach assumes that following an external shock in the economy, the intra-group distributions shift proportionally with the change in mean income. This means that the variance of each distribution is considered fixed, and exogenous to the model; if a shock increases mean income by δ, the income of each HH within a group is raised by δ.

Previous literature reports cases of significant changes in intra-group distributions in Asia in the mid-1980s (Huppi and Ravallion 1991) and following the financial crisis of the 1990s. However, more recent evidence suggests that inequality increases as often as it falls during spells of growth in developing countries, and that neutrality is a defensible first-order approximation (Ravallion and Chen 1997; Decaluwé et al. 1999).[19] In the absence of compelling evidence in either direction in Mozambique, we adopted this neutrality assumption in our analysis. Dervis, de Melo, and Robinson (1982) stress that the complete endogenization of intra-group distributions following shocks remains one of the biggest modeling challenges in studying income distribution in a general equilibrium context.

The procedure allows us to undertake a comparative analysis of the poverty income situation pre- and post-simulation. Such analysis can be done using the Foster, Greer, and Thorbecke (F-G-T) P_α class of decomposable poverty measures that allow the measurement of the proportion of the poor in the population (poverty incidence or head count ratio) and the depth and severity of poverty (poverty gap and squared poverty gap), or the graphical comparative illustration on pre- and post-simulation cumulative distribution functions (CDF) of income. Following Deaton (1997), we chose the second approach.[20]

3.4.3. The Stochastic Dominance Approach to Poverty Analysis

Computations from our HH survey allow us to rank the various HH groups by mean income. However, it is important to test whether the ranking is robust to the choice of the poverty line.[21] This leads to a special type of robustness test, referred to as stochastic dominance, which deals with the sensitivity of the ranking of income levels between groups to the use of different poverty lines. The simplest way to do this—for the robustness of poverty comparisons based on the headcount index of poverty—is to plot the cumulative distribution of income for different HH groups. One can then see whether the curves intersect. If they do not intersect, then the group with the highest curve is poorer than the other group. If they do intersect, then for all poverty lines below intersection, one group is poorer and for all poverty

[19] In a cross-country setting, Gugerty and Timmer (1999) found that whether inequality rises or falls depends on the initial distribution of assets; the broader the initial distribution of assets, the more pro-poor are the effects of growth.

[20] In a CDF, the vertical axis goes from 0 to 100 and the horizontal axis shows our income measure. Suppose we have a sample of 100 HHs (or people) ordered from poorest to richest. The CDF is just the graph of the observation number (which corresponds to percentile in this case) and the income measure. Under that approach, if a shock leads the entire CDF to shift to the right, then the new economic environment stochastically dominates the base.

[21] Note that while we are not computing measures requesting a specific poverty line, the validation of the approach still depends on the existence of a relevant range of poverty lines.

lines above the intersection, the other group is poorer.

Formally, instead of worrying about the proportion of the population with income below *y*, we considered *y* as being continuously distributed in the population with a CDF, $H(y)$. Now consider that there are two HH groups with distributions $H_1(y)$ and $H_2(y)$, and we wanted to investigate whether we could determine that one group is poorer than the other. We considered that distribution $H_1(y)$ first-order stochastically dominates distribution $H_2(y)$ if and only if for all monotonic non-decreasing functions φ(y)

$$\int_{y_0}^{y_n} \varphi(y) dH_1(y) \geq \int_{y_0}^{y_n} \varphi(y) dH_2(y) \qquad (15)$$

where the integral is taken over all relevant levels of income. Considering that $\varphi(y)$ is a valuation function and that monotonicity implies that more is better, distribution 1 can be labeled as better as it has more y, and it stochastically dominates distribution 2. An alternative equivalent way of putting condition (15) is that, for all y,

$$H_2(y) \geq H_1(y) \qquad (16)$$

so that the CDF of distribution 2 is always at least as large as that of distribution 1. Graphically, it is always to the left of distribution 1 that is, therefore, ranked behind.

In discussing poverty, we needed to follow a more restricted form of stochastic dominance in which inequality (16) holds only over a limited range $z_0 \leq y \leq z_1$, where the z are alternative poverty lines. If we have two distributions H_1 and H_2, representing two different HH groups in a region, and we wanted to find out which one shows more poverty and the extent to which the comparison depends on the choice of poverty line z, then if, for all poverty lines z

$$H_2(z) > H_1(z) \qquad (17)$$

the poverty incidence will always be higher for the distribution H_2 when compared to distribution H_1. To test the robustness of the result, we needed to graph the distributions we wanted to compare, and, if one lies above the other over the range of relevant poverty lines, the choice of poverty line within that range will have no effect on the outcome (Deaton 1997).[22]

Figures 8 and 9, show hypothetical CDFs for two HH groups, H_1 and H_2, in two different regions. In Region 1 (Figure 8), distribution H_2 lies everywhere above distribution H_1. In that case, we concluded that the poverty headcount will be higher in H_2 than in H_1, regardless of where we drew the poverty line z. In contrast, in Region 2 (Figure 9), the distribution functions cross, at z*, so we can only make such statements for ranges of poverty lines. In this case, poverty will be higher in H_1 for poverty lines less than z* and higher in H_2 for poverty lines greater than z*, where z* represents a poverty line of close to $500 per capita.

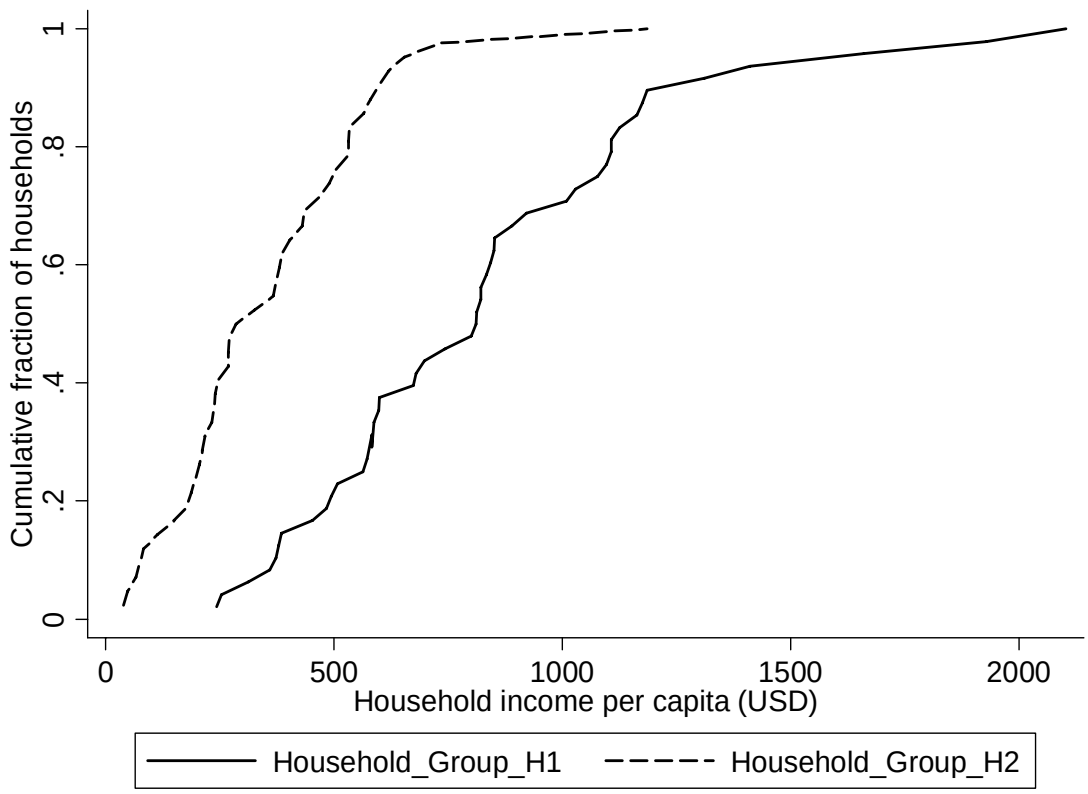
This approach allows for the visual comparison of the impact of alternative simulations relative to the base. It also allows us to depict how income differentiation changes among HH

[22] The poverty rankings of the distributions will be robust to all choices of the poverty line if and only if one distribution first-order stochastically dominates the other.

groups following shocks to the economy, by looking at pairs of CDFs (e.g., for different HH groups) at the base relative to post shock scenarios.

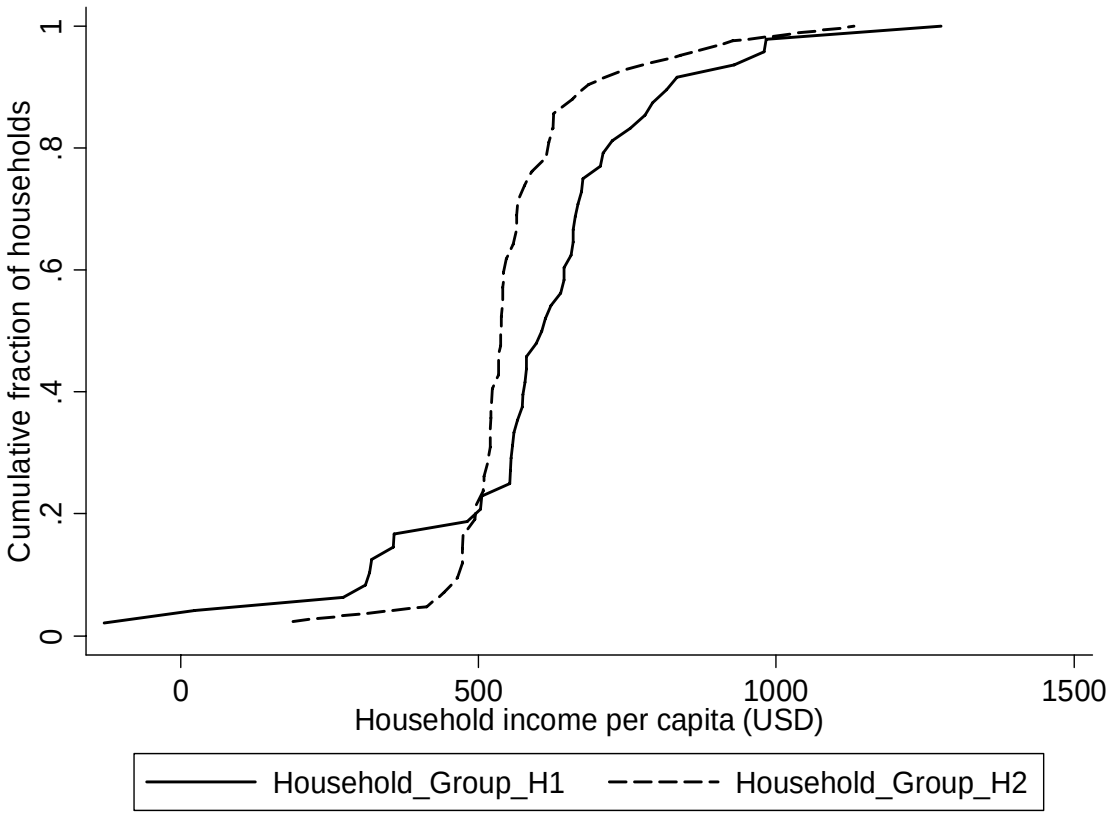
Section 4 uses survey data to illustrate a profile of poverty and inequality for the base year, along with other SAM based statistics. Section 5 undertakes, with the use of stochastic dominance techniques, an analysis following a number of economic shocks that result in changes in the income of RHs in the CGE model that are then used to scale HH income in the survey database through the RH approach. Since we assumed inequality neutrality in comparing pre- and post-shock scenarios, no comparative inequality analysis is performed. The CGE model simulations are implemented using GAMS and the poverty analysis using the DAD (Distributive Analysis/Analyse Distributive) Software.

Figure 8. Distribution Functions of Income per Capita, by HH Group Illustrative Example in Region 1



Source: Author's hypothetical distributions

Figure 9. Distribution Functions of Income per Capita, by HH Group Illustrative Example in Region 2



Source: Author's hypothetical distributions

4. REPRESENTATIVE CHARACTERISTICS OF THE REGIONAL ECONOMY

4.1. Introduction

This section provides a snapshot of the Zambezi Valley regional economy. It combines data from the HH survey and the regional SAM to derive descriptive measures of the regional economy in the base year, including

- demographic and economic structure;
- structure of production, use of factors and intermediary input;
- remuneration of factor income to institutions and structure of HH income and expenditure patterns;
- structure of domestic supply and demand, and foreign trade; and
- a poverty and inequality profile of rural HHs in the study area.

The descriptive statistics in this section are intended to set the stage for a better understanding of the impact of policies and exogenous shocks presented in section 5.

4.2. Demographics and Economic Structure

The total population in the area is estimated at about 980,000 people, i.e., approximately 170,000 rural HHs. Out of those, 27,000 are cotton growing HHs, representing 159,000 people, 46,000 are tobacco growing HHs, representing 277,000 people, 66,000 are non-cotton growing HHs in cotton areas and 31,000 are non-tobacco growing HHs in tobacco areas, representing 370,000 and 174,000 people, respectively.

Table 8 indicates that tobacco growers represent approximately 60% of the population in tobacco concession districts, but only about 28% of the total Zambezi Valley population. The incidence of cotton growers, within the concession districts and across the region, is much lower at 29% and 16%, respectively.

Table 8. Population Data for the Zambezi Valley Region

Population Groups	Number of People	Number of HHs	Share in Area Population (%)	Share in Total Population (%)
Cotton Growing Areas	528,317	92,900	100.0	53.9
Non-growers	369,523	65,986	71.0	37.7
Growers	158,794	26,914	29.0	16.2
Tobacco Growing Areas	451,069	77,248	100.0	46.1
Non-growers	173,871	31,048	40.2	17.8
Growers	277,198	46,200	59.8	28.3
Total	979,386	170,148	-	100.0

Source: Computed from the ZVR-SAM 2003/4 and survey data

An analysis of the structure of the regional gross domestic product (GDP) shows that total absorption (private and government consumption plus domestic investment) represents approximately 94% of GDP, with private consumption being by far the most important

component (Table 9). As previously mentioned, the role of the regional government is limited, which is reflected here in a negligible share of the government in GDP. The Zambezi Valley economy is relatively open, with the sum of imports and exports representing 40% of GDP. Given its relative self-reliance in food production and its orientation toward cash cropping exports, the trade surplus of 6.4% of GDP is not surprising. Potential exists for a further increase in that surplus.

Table 9. Structure of the Regional GDP

Structure of Regional GDP	Value ($US)	Share (%)
Total Absorption	194,891,546	93.6
Private consumption	180,316,323	86.6
Investment	11,868,395	5.7
Government consumption	2,706,827	1.3
Trade Balance	13,325,918	6.4
Exports	48,306,452	23.2
Imports	(34,980,534)	(16.8)
GDP	208,217,464	100.0
Total population (persons)	979,386	
GDP *per Capita*	212.6	

Source: Computed from the ZVR-SAM 2003/4 and survey data
Note: The values are estimated backwards, starting with the per capita income computed from survey data, then expanding with current population figures to actual GDP that gets allocated according to shares extracted directly from SAM (last column).

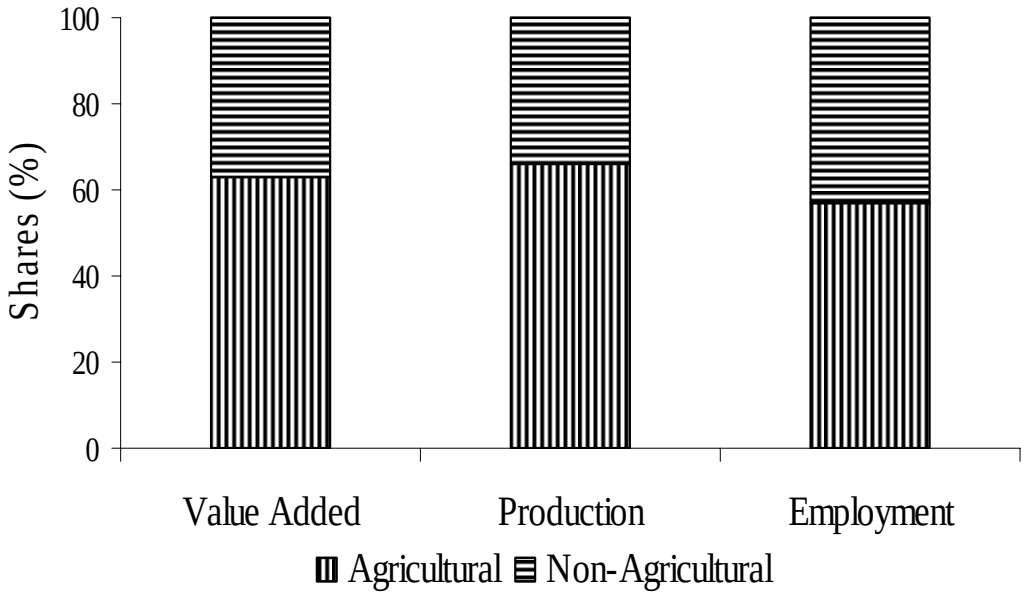
GDP per capita in the region is estimated at $213, varying between $109 and $125 among cotton non-growers and growers, and between $175 and $318 among tobacco non-growers and growers. Appendix Tables B.1 and B.2 present a regional macro SAM (at the highest level of aggregation), and selected characteristics of the Zambezi Valley HHs.

4.3. Structure of Production, Use of Factors, and Intermediate Input

As one would anticipate, the Zambezi Valley economy is predominantly agricultural. Over 60% of the domestic production and domestic value added originate in agricultural activities. More than half of domestic employment also originate from agriculture (Figure 10). Although they confirm the dominance of agriculture, these numbers also indicate that the economy has a great degree of diversification.

Table 10 presents the shares of factors and intermediates by activity. This information is crucial in the analysis of the prevailing production technology in the model. The CGE model structure considers how these two components get substituted or complemented, assuming specific technological options. Here we just look at composition in the base year.

Figure 10. Sectoral Structure of Value Added, Production, and Employment



Source: ZVR-SAM

The analysis indicates that overall, value added constitutes 76% and intermediate input only 24%. There are important variations across major activities. First, all activities, with the exception of the marketing/exporting operations, are predominantly value added activities. Second, within agricultural activities, note that given its relatively greater intensity in the use of chemical input, tobacco farms show relatively higher shares of intermediate input use, 13% to 14%, against just 2% among cotton growers and 0.7% among cotton non-growers. As expected non-tobacco growers in tobacco areas present higher shares on intermediates than farmers in cotton areas. This results from the important technological spillovers that are occurring in tobacco areas, in the form of increased use of chemical input by non-growers. Finally, while fishing is a sector that uses exclusively factors such as labor and capital and no intermediates, livestock, manufacturing, and some type of service (excluding government services) have a more balanced composition of shares between value added and intermediate input.

Table 10. Aggregate Factor and Intermediate Input Shares by Activity

Activities	Value Added Share (%)	Intermediate Input Share (%)
Tobacco Farms		
MLT	87.5	12.5
DIMON	86.2	13.8
Cotton Farms		
C.N.A.	98.0	2.0
DUNAVANT	98.5	1.5
Non-cash Crop Farms		
Non-tobacco	94.1	5.9
Non-cotton	99.3	0.7
Other Primary		
Livestock	66.2	33.8
Fishing	100.0	0.0
Manufacturing		
Foods	55.3	44.7
Beverages	77.3	22.7
Other	100.0	0.0
Services		
Trading	65.3	34.7
Government	100.0	0.0
Other	71.3	28.7
Marketing/export of Cash Crops		
MLT	2.3	97.7
DIMON	2.1	97.9
C.N.A.	4.2	95.8
DUNAVANT	3.1	96.9
Total	76.0	24.0

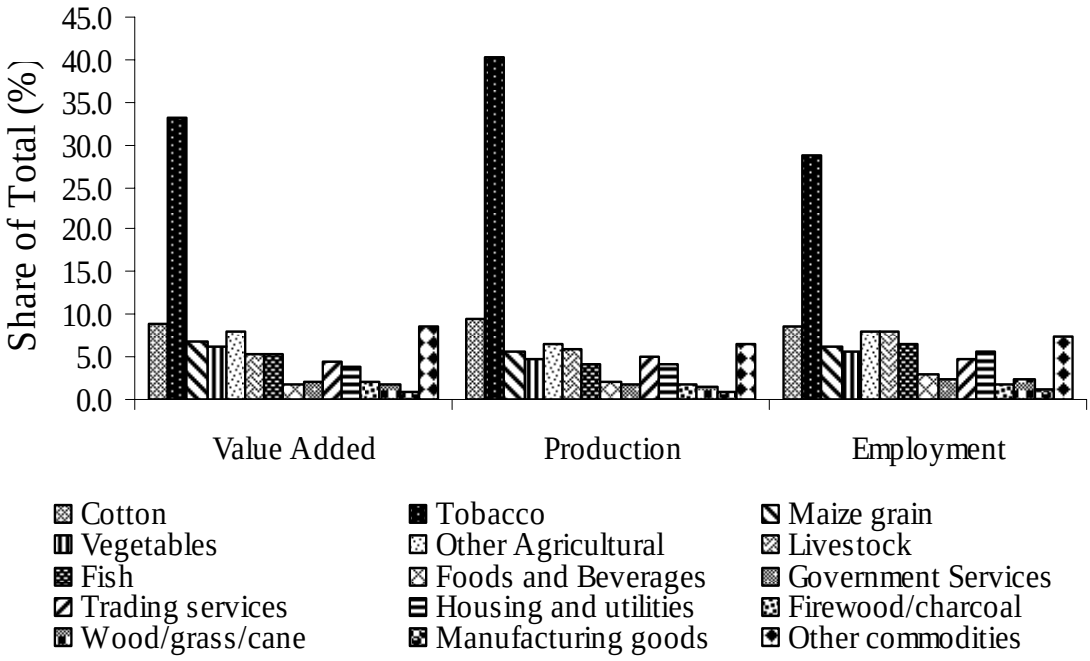
Source: Computed from the ZVR-SAM 2003/4 and survey data

Looking at the distribution of value added, production and employment across commodities further illustrates the dominance of agriculture, particularly of primary cash cropping sectors, such as cotton, tobacco, and maize. While tobacco provides by far the greatest contribution to value added, production, and employment, cotton frequently is not much more important than maize (a major export and food security crop in the region), vegetables, livestock and fish (Figure 11).

Figure 12 shows how factors of production get allocated across competing activities in the base year. It is evident that tobacco farms absorb a great deal of land and wage labor resources. In proportional terms, use of land by cotton growers and non-growing farms in both regions is very similar. Use of family resources in the pre-harvesting season is very much in line with the relative size of the population engaged in specific activities, i.e., the predominance of tobacco growers and cotton non-growers. In the post-season, there is a clear shift away from agriculture, with sectors such as livestock, fishing, manufacturing, and services very much dominating.

Tobacco farms absorb a great deal of hired labor in both seasons. Note, however, that in the post season, the importance of service activities grows significantly as the demand for this type of labor by cash cropping activities and exported-oriented activities, such as maize (among non-growers in tobacco areas), shrinks. Appendix Tables B.3 through B.5 present a more disaggregated picture of factor shares across and within sectors of activity.

Figure 11. Shares of Value Added, Production, and Employment, by Commodity



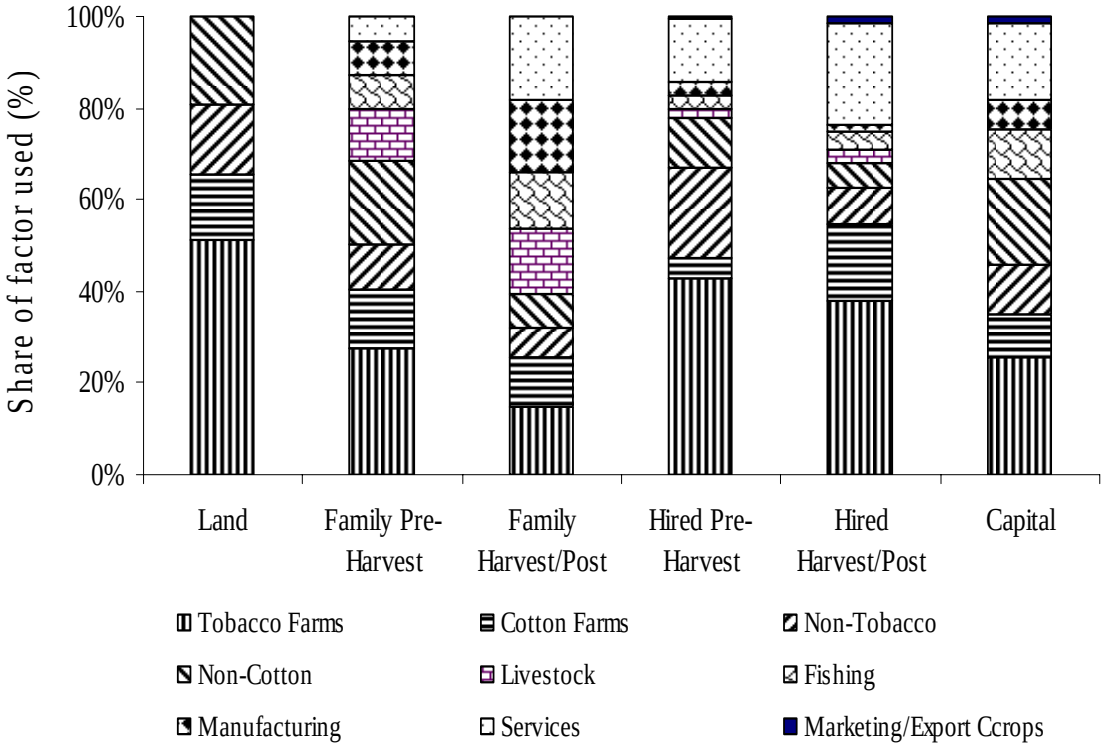
Source: ZVR-SAM

4.4. Factor Income to Institutions and Structure of HH Income

In the SAM/CGE model, factors (labor, land, and capital) are remunerated to the agents that own them, in proportions that mirror the structure of ownership. In our model of the Zambezi Valley region, those agents include domestic HHs that reside permanently in the region, and foreign HHs that temporarily migrate to work as wage laborers. That migrant labor, which in some cases consist of experienced former tobacco smallholders, has played an important role in the recent expansion in the tobacco sector. In economy-wide models, we were particularly concerned with the fact that payments to foreign HHs are potentially spent outside the economy, in which case it generates economic leakages, as opposed to economic linkages that typically are implied when income is spent domestically on domestically-traded goods and services.[23]

[23] While the importance of the Malawian labor cannot be ignored, we should also avoid overstating it. In fact, a great deal of the Mozambican labor, both family and hired, has been exposed to tobacco growing in Malawi in the recent past. Also, in reality, due to close family ties, a great deal of the income can actually be spent in Mozambique as many people, in spite of their nationality, keep resident status on both sides of the border.

Figure 12. Factor Shares Across Sectors of Activity



Source: ZVR-SAM

Figure 13 shows the distribution of factor payments between domestic and foreign HHs. It shows that the share of total factor payments to foreign HHs is relatively small, just over 5%. The importance of foreign HHs is greater when we evaluated their share in the payments to hired labor in the region: they account for about 18% of the total wage labor bill. We ensured that, in modeling the factor payments in the SAM/CGE model, we included factor payments to the RoW that mimic this situation to avoid overestimation of benefits to domestic HHs.

Wage labor is particularly important among non-tobacco growers in tobacco growing areas, for whom, as an income source, it is almost as important as the return to family labor. Figure 14 presents the structure of factor income (and net transfers) for each of the HH groups in the region.

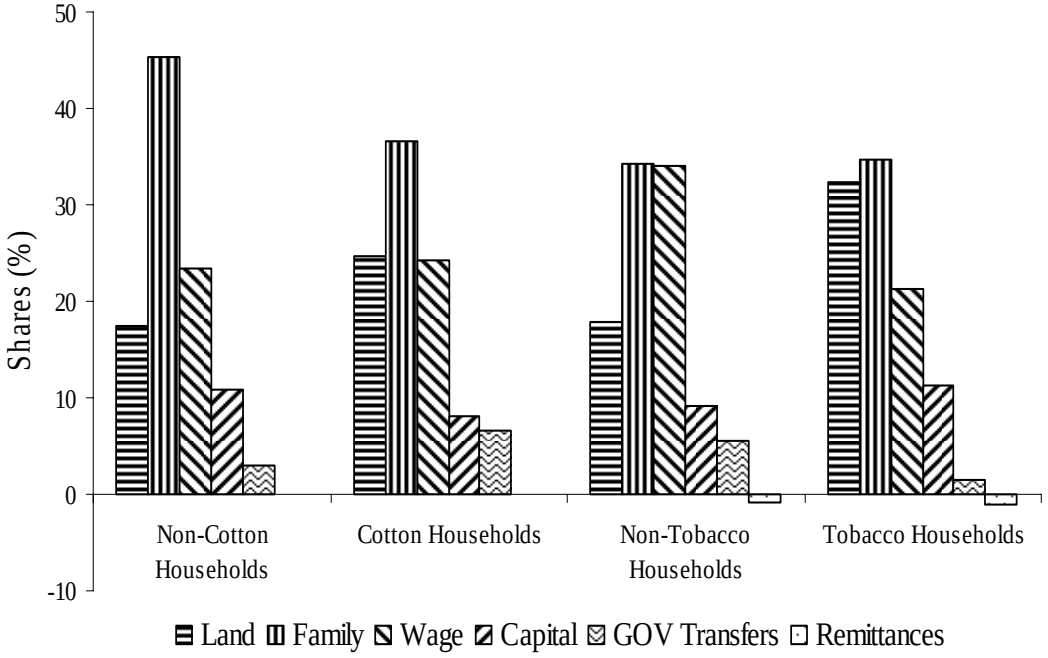
There are several findings worth pointing out. First, in all cases, family labor is the single most important factor of production, only rivaled by land among tobacco growing HHs and wage labor among non-tobacco growers. Second, HHs in the tobacco area are net senders of remittances to outside the region. Third, we were able to document a number of cases where HHs get relatively sizable (for rural standards) government transfers, such as pensions to war veterans. Finally, returns to land are significantly higher among cash cropping HHs. Detailed results are presented in Appendix Tables B.6 and B.7.[24]

[24] To contrast with this factor remunerations approach, we produced a set of survey based "structure of HH income" statistics based on the income approach. See Appendix Table B.8.

Figure 13. Factor Payments to Domestic and Foreign HHs

Source: ZVR-SAM

Figure 14. Shares of Factors and Transfers in HH Income



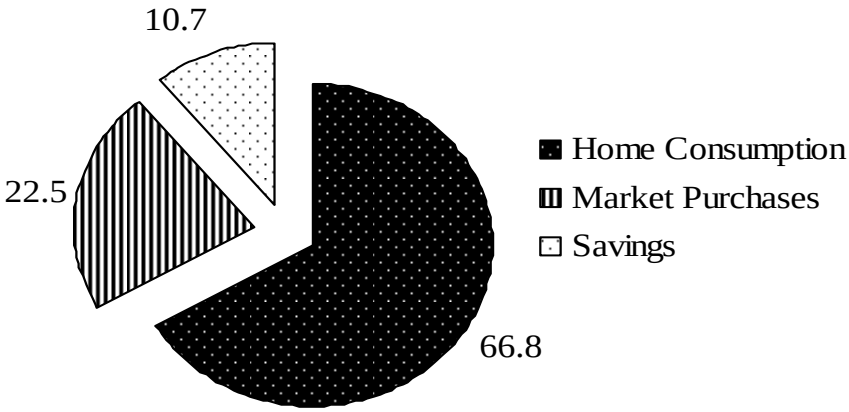
Source: ZVR-SAM

Structure of HH Expenditure: Income earned by HHs in the region can be spent on consumption goods and services, saved, or transferred to other institutions, e.g., inter-HH transfers, transfers to HHs outside the region or taxes to the government. In our model, we

did not account for intra-HH transfers, and transfers to the RoW were netted out and entered as net income to domestic HHs from the RoW. Transfers between domestic HHs and the government were also netted out and entered as net payments from government to HHs. As a result, HH expenditure, as represented in SAM, was reduced to home consumption, market purchases of goods and services, and private savings.

Figure 15, generated from the macro SAM, presents the aggregate structure of HH expenditure in the region. This structure is very typical of a rural developing economy, with the share of home consumption as the dominant category, and the prevalence of low savings rates.

Figure 15. Structure of HH Expenditures



Source: ZVR-SAM

Table 11 presents a more disaggregated structure of HH expenditures that identifies sub-categories of home consumption and purchased goods and services, and breaks down the results by HH group. These results were generated using both survey data to disaggregate the shares in home consumption, and the cash share expenditures retrieved from IAF to input on the different HH groups.[25]

Several results stand out. First, all HH groups have a high home consumption share, dominated by the retained value of agricultural production and, to a lesser extent, livestock, particularly among non-growers. Second, while in cotton areas the value of retained maize is more important than all other agricultural products, in tobacco growing areas the situation appears to be more balanced with maize and other aggregated agricultural products exhibiting

[25] The IAF expenditures were attributed by ranking HH groups in both data sets, for the relevant enumeration areas as coded in the INE master sampling frame. Although we averaged middle quartile cash expenditure shares from IAF and attributed them to the two middle income groups in our data set, the shares in the table for those two groups differ because we computed them over total income that includes home consumption.

Table 11. Structure of HH Expenditures (%)

Expenditure Category	HH Groups: Cotton Area HHs: Non-growers	Cotton Area HHs: Growers	Tobacco Area HHs: Non-growers	Tobacco Area HHs: Growers	All Region
Home Consumption	73.4	64.5	67.0	63.7	66.8
Agricultural goods	59.8	58.0	56.9	58.4	58.3
Maize	31.3	33.4	28.8	28.4	30.0
Other	28.4	24.6	28.1	29.9	28.4
Animal/animal products	13.4	6.4	10.0	5.3	8.3
Foods and beverages	0.2	0.1	0.1	0.1	0.1
Marketed Goods/services	18.3	25.8	22.6	24.0	22.7
Agricultural goods	1.7	4.6	4.0	4.3	3.7
Animal/animal products	1.1	4.0	3.5	3.2	2.9
Foods and beverages	1.5	3.6	3.1	3.7	3.1
Non-food items	12.9	12.4	10.9	12.4	12.2
Education	0.4	0.3	0.2	0.2	0.3
Health	0.7	0.9	0.8	0.3	0.6
Savings	8.2	9.8	10.5	12.3	10.6
Total	100.0	100.0	100.0	100.0	100.0

Source: IAF and Zambezi Valley Cotton and Tobacco Concession Areas Study Survey 2004

the same shares. Third, irrespective of HH type or ranking, retained value of homemade foods and beverages are extremely low. However, when it comes to marketed commodities, grower HHs tend to spend more on those items. Fourth, spending on animal/animal products is higher among cotton growers and all HHs in tobacco growing areas. Finally, against expectations, expenditure shares in goods with (typically) high income elasticity of demand, e.g., non-food items, health, and education, do not show any major differences across groups in the region. There are two possible explanations for this finding. First, it may be that within the income ranges and preferences observed locally, demand for these goods is not income elastic. Second, the supply of public sector services such as health and education, is relatively restricted (low density of schools and health posts), which by itself limits access. The absence of a reliable transportation system further reduces accessibility for all, regardless of income. In addition, while the cash cost may be low, the opportunity cost of sending a child to school, rather than having them work on the farm or in a business, can be high.

4.5. Domestic Supply and Demand, and Foreign Trade

As discussed earlier in this paper, the regional economy produces goods and services that are home consumed, sold domestically, and/or exported outside the region. Some exported goods include cotton, tobacco, maize grain, groundnuts, roots, vegetables, goats, alcoholic beverages, etc. While a great deal of domestic demand is for goods produced domestically, many consumption items, particularly non-primary, are actually imported from other parts of the country, or even brought in from neighboring countries. Examples of imported items include rice, salt, sugar, tea, seeds and chemical input, fuel, etc. See Appendix Table B.9 for a detailed list of imported and exported commodities and their importance. The Zambezi Valley economy is quite open to trade. In the analysis that follows, we first looked at the structure of imports and exports by sector. Then, we looked at the commodity structure of

imports and exports in the region. Finally, we evaluated the share of exports in marketed output and the share of imports in domestic demand.

Figure 16 shows that the regional exports are predominantly agricultural. Only 6.6% of the exported value is in non-agricultural products, including small livestock (goats and birds) and home produced traditional beverages. In contrast, 95% of the imports consist of non-agricultural products, most of which are directly imported from Malawi.

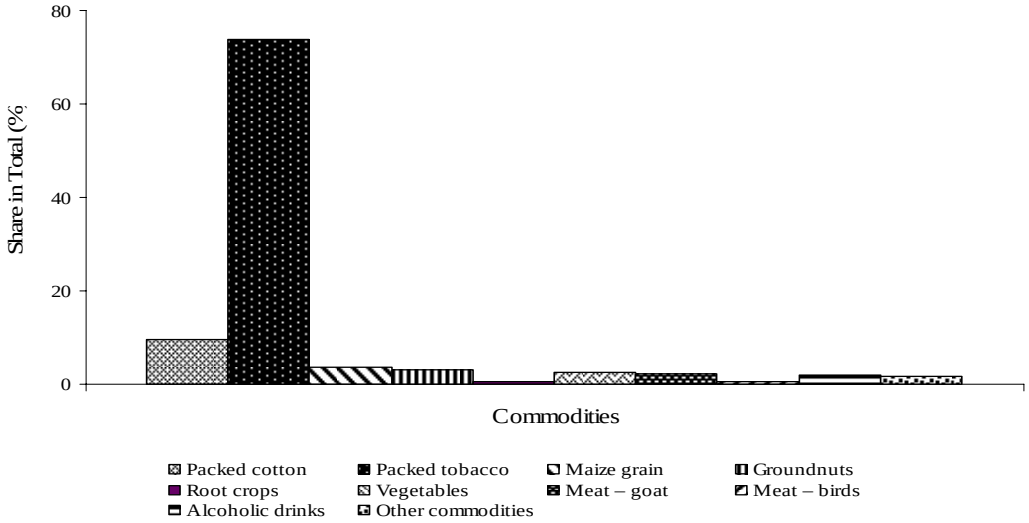
Tobacco is by far the most important exported product in the region, about 74% of the exported value, followed by cotton with 10% and maize grain with 4% (Figure 17). Other commodities with at least 2% of the total export value include groundnuts, vegetables, and goats. The most important imports are chemical input (fertilizers and pesticides) and seeds, about 31% of the total import value, followed by fuel with 19%, textiles/footwear and hygiene products with 9% each. Commodities with at least 2% import share include rice, beef, cooking oil, sugar, and salt. Appendix Table B.9 presents the results in greater detail.

Figure 16. Sectoral Structure of Exports and Imports

Source: ZVR-SAM

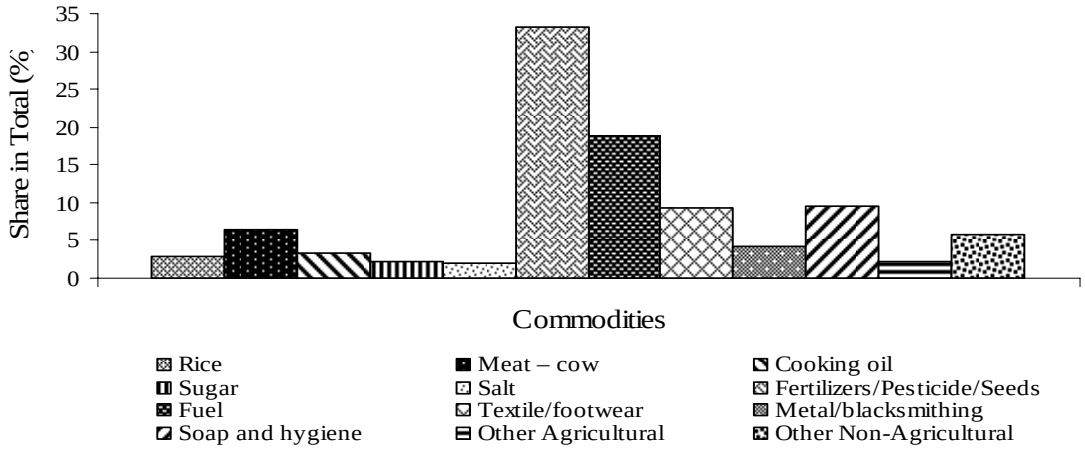
In the CGE model, the allocation of marketed output between domestic sales and exports, and the domestic consumption between domestically produced goods and imports are functions of relative prices. Figure 19 presents the share of exports in output and of imports in domestic demand for the base year. Of the total marketed output, about 32% is exported and the remainder is sold in the local market. Note that commodities such as cotton and tobacco are

Figure 17. Commodity Structure of Exports



Source: ZVR-SAM

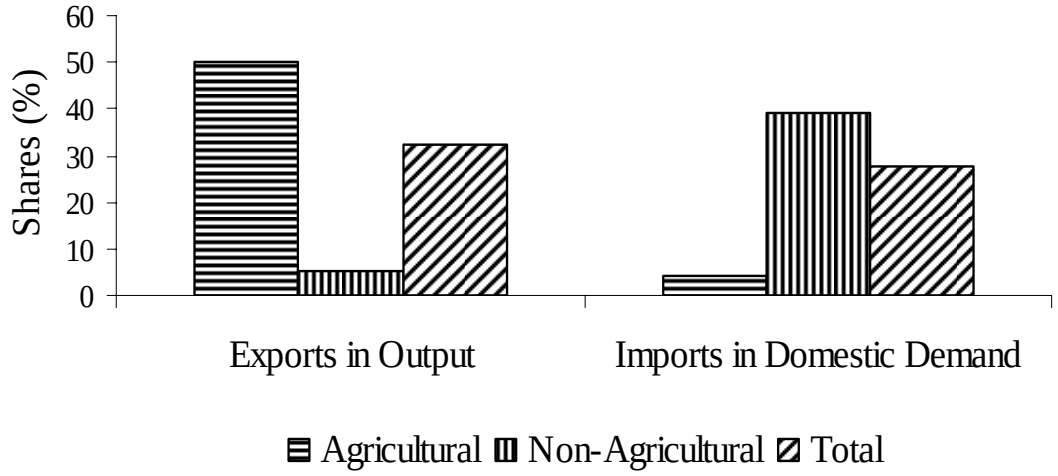
Figure 18. Commodity Structure of Imports



Source: ZVR-SAM

entirely exported, and about 50% of the marketed maize is exported. On average, only 5.3% of the non-agricultural sales are exported, against about half of the agricultural sales. This relatively high share of exported agricultural marketed output may seem large. However, this result is not surprising. In addition to the fact that cash crops are entirely exported, most of the agricultural food production is actually consumed on the farm and domestic markets for those food crops are relatively thin.

Figure 19. Shares of Exports in Output and Imports in Domestic Demand by Sector



Source: ZVR-SAM

Regarding the share of imports in domestic demand, we found a completely different picture. About 27% of domestic demand value is imported. Among agricultural commodities demanded, only 5% of the value is imported, while for non-agricultural commodities over 94% is imported. This is consistent with the prevailing regional commodity composition of imports, that is predominantly non-agricultural, and export, that is predominantly agricultural.

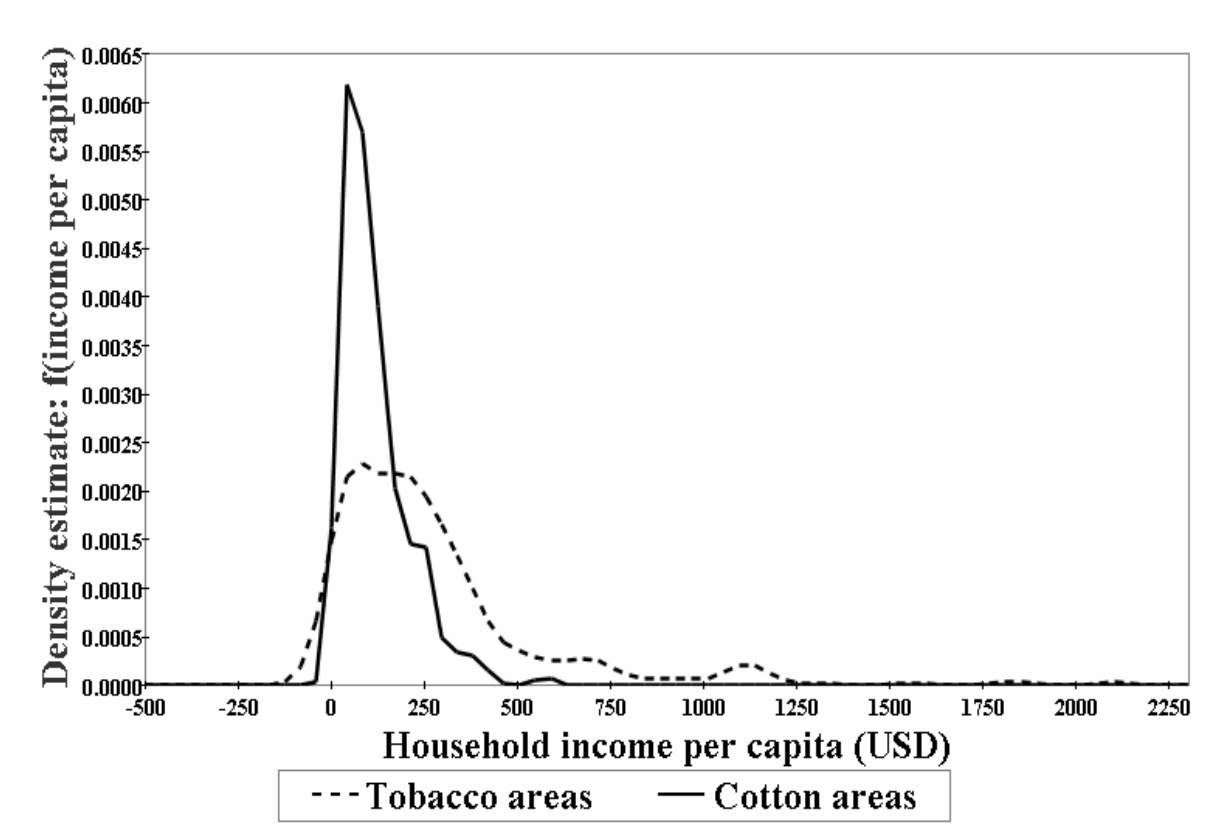
Poverty and Inequality Profile: This section presents a profile of HH income poverty and inequality in the Zambezi Valley cash cropping economies for the base year using data from the HH survey. We used cumulative distribution curves of HH income per capita to undertake stochastic dominance analysis of poverty, as described in section 3.4.3. The analysis of inequality uses coefficients of variation, Gini concentration ratios, and Lorenz curves.

Income per capita differs substantially in the region between cotton and tobacco concession areas, with the latter exhibiting a clear advantage. Figure 20 illustrates the density curves for HH income per capita by concession area, including all HHs irrespective of their cash crop growing status. Several points are worth noting. First, as expected in a rural African economy, both curves are skewed to the right. Second, tobacco areas present a wider dispersion of income.

As compared to cotton areas, tobacco areas appear to have a larger proportion of negative income per capita, but also a much greater share at the higher end of the income spectrum. Cotton income is much more concentrated around the lower end. Stochastic dominance analysis for the two concession areas, using distribution curves in Figure 21, shows that for any relevant poverty line, HHs in cotton areas are poorer than their counterparts in tobacco growing areas.[26]

[26] Note that as per the definitions introduced earlier, there is no first degree stochastic dominance over the entire income range; at unreasonably low poverty lines, the curve for the cotton areas dominates the one for the tobacco areas. This is somewhat expected, as tobacco growers with low yields will incur large losses due to high input costs.

Figure 20. Density Curves of Income per Capita, by Concession Area in Zambezi Valley, Mozambique, 2003/4

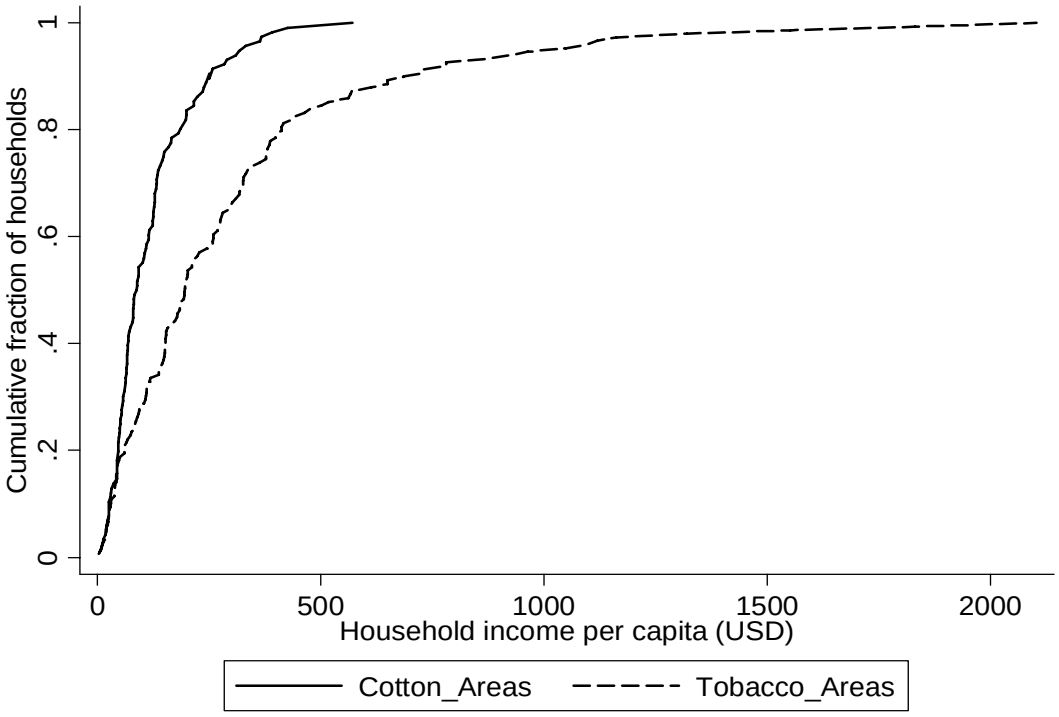


Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey 2004

This CDF plot also confirms indications from the density curve that income per capita in cotton areas is significantly lower. Nearly all HHs in the cotton area earn income per capita lower than $400 per capita. More importantly, about 60% earn $100 or less, and 80% earn $200 or less. Top income in tobacco areas is close to $2,000, while 60th and 80th percentile incomes are about double those in cotton areas ($200 and $400, respectively). Median per capita income in cotton areas is approximately $88 against $184 in tobacco areas. Computed mean incomes per capita are $120 and $280, respectively.

Differences in income from the cash crop contribute substantially to these overall income differences; mean and median income from cotton is $94 and $77, respectively, while the same figures for tobacco are $731 and $364. In Figures 22 and 23 we compared the cumulative distributions for growers and non-growers in tobacco and cotton concession areas, respectively.

Figure 21. Distribution Curves of Income per Capita, by Concession Area in Zambezi Valley, Mozambique, 2003/4

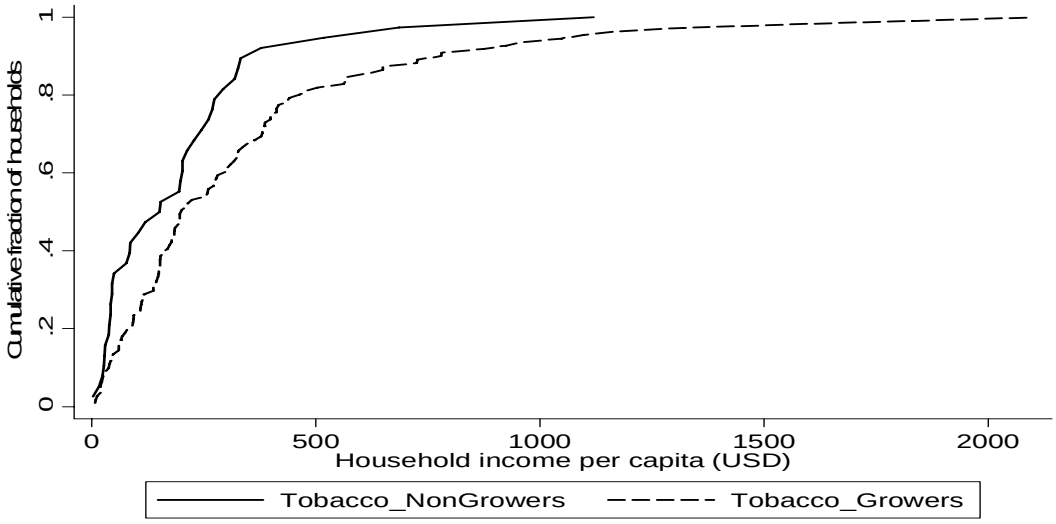


Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey 2004

In both areas, for poverty lines at or below median per capita income, comparisons are inconclusive. Indeed, in tobacco growing areas (Figure 22), the CDFs overlap at very low levels of less than $50. At levels $50 to $150, the grower HHs dominate the non-growers, but the situation is again unclear around poverty lines near the area's median. For poverty lines defined above the median ($184 per capita), and more clearly above the mean ($280 per capita), grower HHs clearly dominate non-growers.

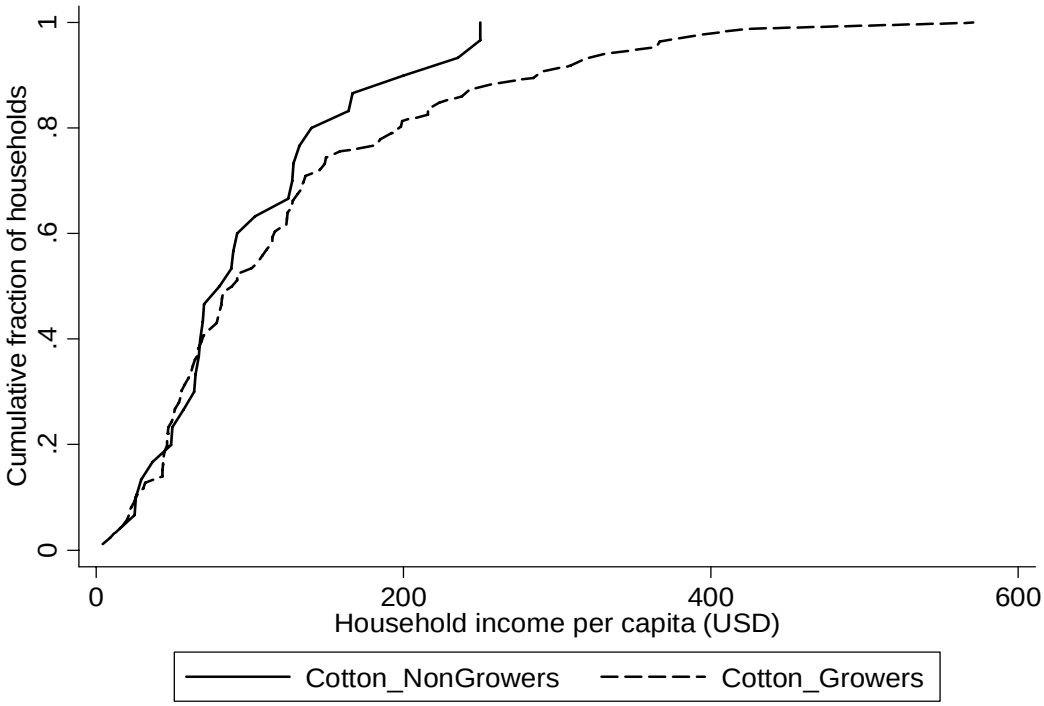
In cotton growing areas (Figure 23), poverty differences between the two groups are very unclear for all poverty lines defined below mean per capita income. For poverty lines greater than the mean, i.e., over $120, growers clearly dominate non-growers, indicating that poverty incidence is greater among non-growers.

Figure 22. Distribution Curves of Income per Capita, by HH Group in Tobacco Concession Areas



Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey 2004

Figure 23. Distribution Curves of Income per Capita, by HH Group in Cotton Concession Areas



Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey 2004

Table 12 and Figure 24 present measures of inequality in the base year. By all standards, inequality appears to be more severe in tobacco concession areas when compared to cotton areas. This is illustrated by the higher coefficient of variation, 1.17 (tobacco areas) to 0.78 (cotton areas), higher Gini concentration ratio (0.54 and 0.40), and the fact that Lorenz curves for HHs in tobacco areas lie everywhere outside the Lorenz curves for HHs in cotton areas.

Table 12. Measures of Inequality

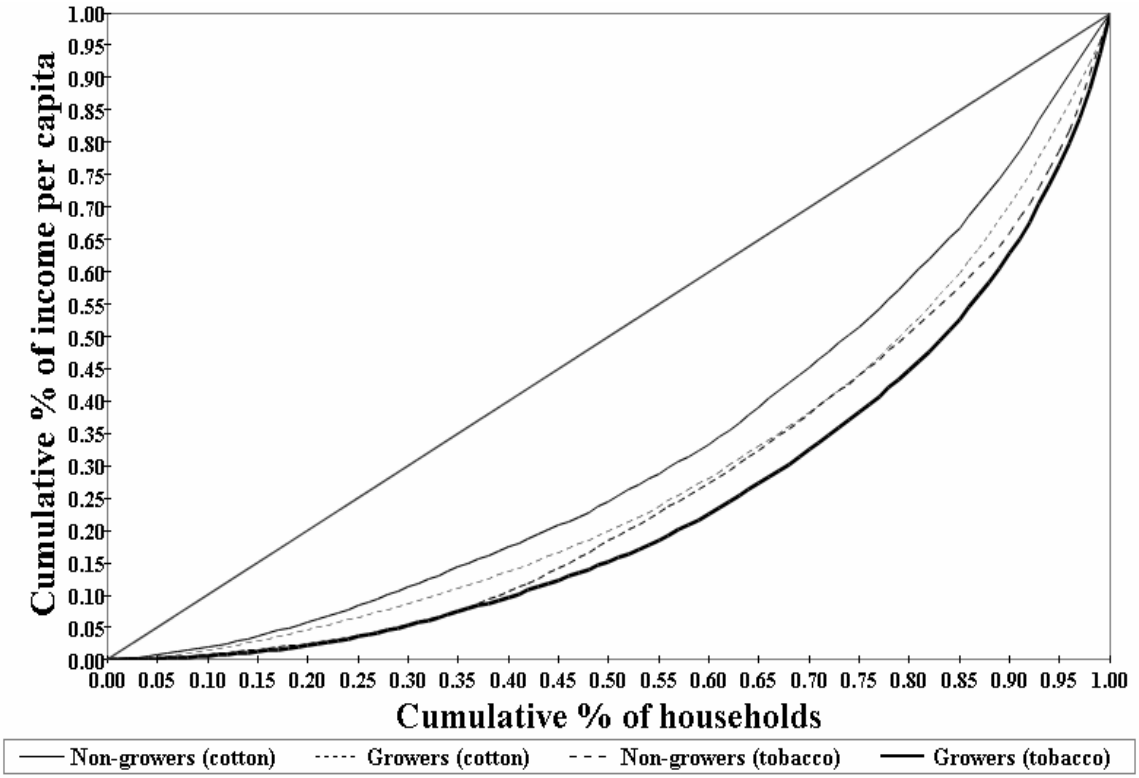
HH Groups in Concession Areas	Coefficients of Variation of per Capita Income	Per capita Income Concentration Ratios (Gini)
Tobacco Areas		
Non-grower HHs	1.06 (0.165)	0.52
Grower HHs	1.19 (0.102)	0.56
All HHs	1.17 (0.104)	0.54
Cotton Areas		
Non-grower HHs	0.64 (0.068)	0.35
Grower HHs	0.86 (0.064)	0.44
All HHs	0.78 (0.060)	0.40
All HHs in the Region	1.26 (0.101)	0.53

Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey 2004

Comparing inequality among groups within the same area shows, first, that in both areas inequality is more severe among cash crop growers. Second, these differences are more accentuated in cotton areas, where Gini ratios exhibit a difference of 11 points as compared to only 4 points in tobacco growing areas. The coefficients of variation give the same indication.

A visual interpretation of the Lorenz curves (Figure 24) provides further insights. It further clarifies that in cotton areas, inequality is more accentuated among grower HHs, as their curve lies everywhere below the curve for non-growers. Forty five percent of the non-growers of cotton receive about 20% of the total income received by that group, while among growers, 45% receive only 15% of the group's total income. This higher level of inequality among cotton growers persists at all percentiles.

Figure 24. Lorenz Curves for HH Income per Capita, by HH Group in Zambezi Valley, Mozambique, 2003/4



Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey 2004

The picture is a bit different in tobacco areas. For instance, at population cumulative percentiles up to 40%, there are seemingly no differences between the two HH groups. At that level in each group, 40% of the population receive just over 5% of the total income of the respective group, which indicates a very high level of inequality. Inequality becomes more severe among growers as we move up the curve; 60% of non-growers receive 25% of that group's total income, while 60% of growers get only 20%.

5. POLICY SIMULATIONS WITH THE REGIONAL CGE MODEL

5.1. Introduction

To assess the impact of expansion of cash cropping activities and of alternative policies in cash cropping sectors on HH per capita income, we considered a number of alternatives with respect to the availability of resources, and the extent of their mobility and allocation across various economic activities. In the CGE model we accomplished this by defining the specific mechanisms that guide factor market adjustments in the presence of exogenous shocks. Those alternative mechanisms are discussed in some detail in section 3.2.2.

In Mozambique in general, and in the Zambezi Valley economy in particular, the issue of availability and mobility of resources is important for various reasons. Post-war growth in agriculture has been primarily due to some area expansion (significant relative to the base, though still limited relative to its potential full employment) and labor force growth, with limited gains in crop productivity. In fact, a great deal of the growth in the Zambezi Valley cash cropping economies was possible due to the available pool of resources. These included land for scheme expansion, and labor, some of which was drawn from Malawi and from less dynamic domestic areas with fewer attractive employment opportunities.

There are some fundamental questions in this context. First, under what endowment/mobility scenarios can the Zambezi Valley economy continue to grow? In other words, can the simple injection of additional resources by the CF companies, without continued growth in land and labor supply and/or gains in the productivity of the existing resources, ensure growth in cash crop production that is capable of generating broad-based growth in the regional economy? Second, how do changes in world market conditions, e.g., fluctuations in import prices of input and export prices of output, affect the regional economy? Finally, how do all these changes compare to each other regarding their effects on HH income levels? In this analysis, we considered selected exogenous economic shocks. While we have identified a large menu of interesting experiments, our analysis will be limited to the following shocks:

- An increase in capital endowments specific to cash cropping;[27]
- Productivity gains in cash cropping sectors;
- Changes in world market conditions for tradable goods. The simulated shocks include:
  - •An increase in import prices for intermediate input, e.g., pesticides, fertilizers, and seeds;
  - •An increase in export prices for cash crops (cotton and tobacco), and maize grain; and
- A government trade policy with respect to cash cropping sectors, e.g., export taxes.

The choice of experiments was based on an assessment of their importance for the current policy debate in Mozambique, ensuring a mix of exogenously determined variables, such as world prices,[28] discretionary variables like export taxes, and variables that can be influenced

[27] This includes the implicit increase in activity specific capital, resulting from increased support by firms to smallholders in terms of extension assistance and other support that increases their managerial ability. In reality, it is in fixed proportion to intermediate input in those activities, reflecting, therefore, a proportionally similar increase in the supply of intermediates by firms to smallholders.

[28] Note that world market conditions may actually change in an opposite direction. Therefore, one should keep in mind that there can be a change in the direction of the effects shown here. For example, a drop in world cotton/tobacco/maize prices will hurt HH income and a decrease in import prices for input will be beneficial.

by private sector actions, such as productivity and the level of capital injections in cash cropping schemes. The assumption is that the government may have the ability to influence private sector decisions through incentive mechanisms.

There are several circumstances of the economic environment in the Zambezi Valley economy that shape the choice of shocks for our policy simulations. First, there is still room for expansion of agriculture in Mozambique. Given the absence of a wide range of cash generating opportunities in rural areas, and the availability of land and labor resources, cash cropping is viewed as a potentially important sector where direct and indirect effects can be maximized. Earlier analysis indicates that profits in both sectors can be increased with the expansion in land area, but total crop and total HH incomes grow significantly only in tobacco growing areas. We further investigate, in this section, the economy-wide effects of expansion in both sectors. Second, several studies in the cotton sector have emphasized low prices and poor productivity at the farm level as factors leading to the stagnation of cotton farmer income in Mozambique (World Bank 2005; Tschirley, Ofiço, and Boughton 2005). [29] Benfica (2006) documents the low profitability of the crop relative to tobacco in the Zambezi Valley region.[30] We assessed the impact, on the different HH groups, of increased productivity and prices. Third, a proposal to impose an export tax on raw tobacco, as a way of encouraging domestic processing, has been the object of great controversy in recent years. Benfica et al. (2005) discuss the implications of that policy in a cost-benefit framework, and conclude that the imposition of such a tax at this stage of development of the tobacco sector is not appropriate. We pursued the analysis of that policy within an economy-wide framework to better inform its possible implications to rural poverty. Fourth, given the importance of imported chemicals in the package supplied to cash crop growers (fertilizer for tobacco, and pesticides in both sectors), we analyzed the implications of changes in their world prices to poverty in the study area. Finally, maize is an important crop both for food security and as a cash crop for many farmers in the region. Some of it is actually exported to neighboring countries or deficit areas inside Mozambique. We assessed the impact of changes in maize export prices to poverty reduction in the study area.

We conducted the analysis separately for each concession area. The justification for this separation is that there are no overlaps of firm concession areas, so that a HH does not have the choice of moving into a different cash crop without physically moving from the area. Although migration occurs, no evidence was found that supported the idea that HHs were moving as part of a strategy to engage in alternative cash crops.

The implementation of the analysis on a sub-regional basis implied that the regional SAM had to be divided into two independent matrices with similar structures. The task of creating separate matrices was facilitated by the structure of the aggregated SAM that included highly disaggregated activity and HH accounts mapped out on the basis of the relevant cash crops and conveniently linked by distinct factor accounts. Background data from the field survey originally used to generate the regional SAM, including its non-farm accounts, was also used in this separation. The SAMs were balanced separately through the Cross-Entropy method and used to calibrate two CGE models and undertake policy simulations.

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[29] In fact, Mozambique pays the lowest prices in the region; the 1998-2002 average producer prices were $0.16 per kilogram, compared to $0.22 in Zambia and Tanzania and $0.25 in Zimbabwe (Poulton et al. 2004). Likewise, yields are among the lowest in Africa; 0.51 tons per ha in 2003/4, compared to 0.9 tons in Zimbabwe and over 1.0 ton in West Africa (Lemaitre, Fok, and Jeje 2001).

[30] In the tobacco sector, with the exception of some indirect complaints blamed on poor grading by companies, prices (and productivity) have not been much of a problem.

Initially, for each area, we examined the simulations under the alternative scenarios, considering individual impacts (each simulation individually), and also combined simulations, where "a" (the injection of activity specific capital in cash cropping sectors) is implemented in conjunction with each of the other simulations. The scenarios experimented included: (a) full employment with full mobility of all factors; (b) full employment of capital with unemployment and full mobility of labor and land; and (c) unemployment and full mobility of all factors, except activity specific CF capital that is assumed fully employed at the post-shock level. Note that the unemployment closure (c) implies that supply of resources is not restricted and can be brought into production to meet the demand from expanding activities. Results for the three scenarios are presented in Tables 13 and 14 for tobacco and cotton areas, respectively.

Table 13. Effects on HH Income of Alternative Simulations in Tobacco Areas

	--- % Changes in HH Income per Capita ---					
	Full Employment		Semi-unemployment		Unemployment	
Simulations	Non-growers	Growers	Non-growers	Growers	Non-growers	Growers
Individual Shocks:						
CF capital	1.42	-2.08	2.99	6.15	17.84	18.11
Productivity	4.21	3.34	8.43	11.63	17.95	30.09
Export price – tobacco	3.94	3.79	4.01	4.88	23.19	44.02
Export price – maize	2.24	1.50	5.90	6.94	31.38	53.06
Import price – inputs	-0.71	-1.32	-1.88	-2.84	-4.50	-6.37
Export tax – tobacco	-0.74	-4.52	-3.82	-7.28	-6.25	-10.4
Combined Shocks:						
Productivity	7.36	1.35	22.58	21.20	43.16	61.98
Export price – tobacco	4.14	1.66	9.30	9.14	49.01	79.04
Export price – maize	3.42	-0.62	12.15	8.78	47.60	67.54
Import price – inputs	0.51	-3.16	3.34	-0.77	8.67	5.60
Export tax – tobacco	0.02	-6.17	-0.78	-6.54	6.07	0.71

Source: ZVR-CGE model simulations

Note: The individual shocks are in the magnitude of 15% in each case. The combined shocks include a 15% expansion in CF capital with another 15% shock. The simulations use a flexible exchange rate closure.

In both areas, we found that under full employment of all factors, closure (a), economic expansion, is very limited. Even if we assumed that the existing factors are 15% more productive, the effects on HH income are very limited, and we found little mobility of factors across activities. Likewise, the effects of changes in world market conditions, although resulting in the expected direction, are small. Under closure (b), the effects are more sizable. However, the full employment assumption of non-cash crop capital is highly unrealistic. Indeed, the non-cash crop stock of capital is very much like a complement of HH labor supply in the region that is assumed available/unemployed in this closure. This leads to

Table 14. Effects on HH Income of Alternative Simulations in Cotton Areas

	--- % Changes in HH Income per Capita ---					
	Full Employment		Semi-Unemployment		Unemployment	
Simulations	Non-growers	Growers	Non-growers	Growers	Non-growers	Growers
Individual Shocks:						
CF capital	1.03	-1.92	4.43	1.22	14.20	13.46
Productivity	1.02	2.14	6.23	9.93	14.48	23.10
Export price – cotton	0.64	2.06	2.21	4.07	5.71	9.33
Export price – maize	1.80	2.12	4.71	5.42	21.44	31.06
Import price – inputs	-0.11	-0.21	-0.32	-0.45	-1.17	-1.56
Export tax – cotton	-0.16	-1.61	-1.02	-2.52	-2.20	-3.98
Combined Shocks:						
Productivity	1.34	0.30	6.06	5.84	31.20	40.46
Export price – cotton	1.93	-0.25	7.81	5.70	20.54	23.71
Export price – maize	2.84	0.06	3.38	1.30	39.83	49.94
Import price – inputs	0.91	-2.10	4.00	0.75	12.88	11.72
Export tax – cotton	0.65	-3.31	2.35	-1.86	11.39	8.59

Source: ZVR-CGE model simulations

Note: The individual shocks are in the magnitude of 15% in each case. The combined shocks include a 15% expansion in CF capital with another 15% shock. The simulations use a flexible exchange rate closure.

limitations in the use of the available land and labor in the expansion process by the activities that receive capital injections, and also in the adjustment of other activities. In closure (c), where all factors are assumed to be available for use in the expansion process, we observed that HH income is responsive to the various shocks. This closure also shows some important indications of indirect effects of shocks in cash cropping sectors on non-grower HHs in the adjustment process through the marketing mechanisms.

We argue that closure (c) is the most realistic assumption in the Zambezi Valley, for three reasons. First, population pressure, land degradation, and the resulting low returns to agriculture in Malawi put increasing pressure on scores of people to migrate as laborers; cash cropping areas of Mozambique are one of the obvious destinations. Second, there are still localities in the study area that are not part of the concession system, leaving room for further expansion of land and labor. Third, an increasing number of people from other parts of Mozambique are willing to migrate to production areas if the returns are compensating. Urban unemployment and lack of economic opportunities are very real in central Mozambique. This is true for both cotton and tobacco growing areas. Finally, within each area, the proportion of land area still uncultivated is relatively high,[31] which means that more land can be brought into production if additional labor is available in the region and capital is made available by profit seeking outgrower companies.

In the following analysis, we assumed that all factors are fully mobile and available for use, following an injection of activity specific capital combined with a series of other shocks. Table 15 presents, for each concession area, the list of shocks and the effects on HH income per capita by HH type.[32]

[31] In 1995, the total arable land in Tete Province was estimated in 49,000 square kilometers (SKMs), of which 16 SKMs were used for permanent agriculture, 16,724 SKMs for shifting agriculture, and the reminder was grass land, wooded grassland, and shrub.

[32] These results are based on a flexible exchange rate closure for the RoW. These results are consistent with the literature for developing countries.

Table 15. Effects on HH Income of Alternative Simulations, Assuming Unemployment and Full Mobility of Factors

Simulations	Shock (% Change)	--- % Changes in Income per Capita --- HH Types: Non-grower HHs	Grower HHs
Tobacco Areas			
CF Capital	15.0	17.84	18.11
+ Productivity	15.0	43.16	61.98
+ Cash crop export price	15.0	49.01	79.04
+ Export price – maize	15.0	47.60	67.54
+ Import price – inputs	15.0	8.67	5.60
+ Export tax	15.0	6.07	0.71
Cotton Areas			
CF Capital	15.0	14.20	13.46
+ Productivity	15.0	31.20	40.46
+ Cash crop export price	15.0	20.54	23.71
+ Export price – maize	15.0	39.83	49.94
+ Import price – inputs	15.0	12.88	11.72
+ Export tax	15.0	11.39	8.59

Source: Zambezi Valley CGE model simulation results

For simplicity, we set all shocks at 15% from the base values represented in the base year SAM. In the following analysis, we used the stochastic dominance approach described earlier whose outcomes mirror the results in the Table. We examined the impact of each shock on the income of the two HH groups in each area and examine the mechanisms through which they arose. While the SAM base scenario represents a base year for an economy in equilibrium, it should be clear that model results are only representative of the direction in which a system will begin to change toward a new equilibrium until some (different) shock sets it on still another path. The length of run for the impact to take effect is, therefore, undefined. In addition to that, population is assumed constant during the adjustment process.

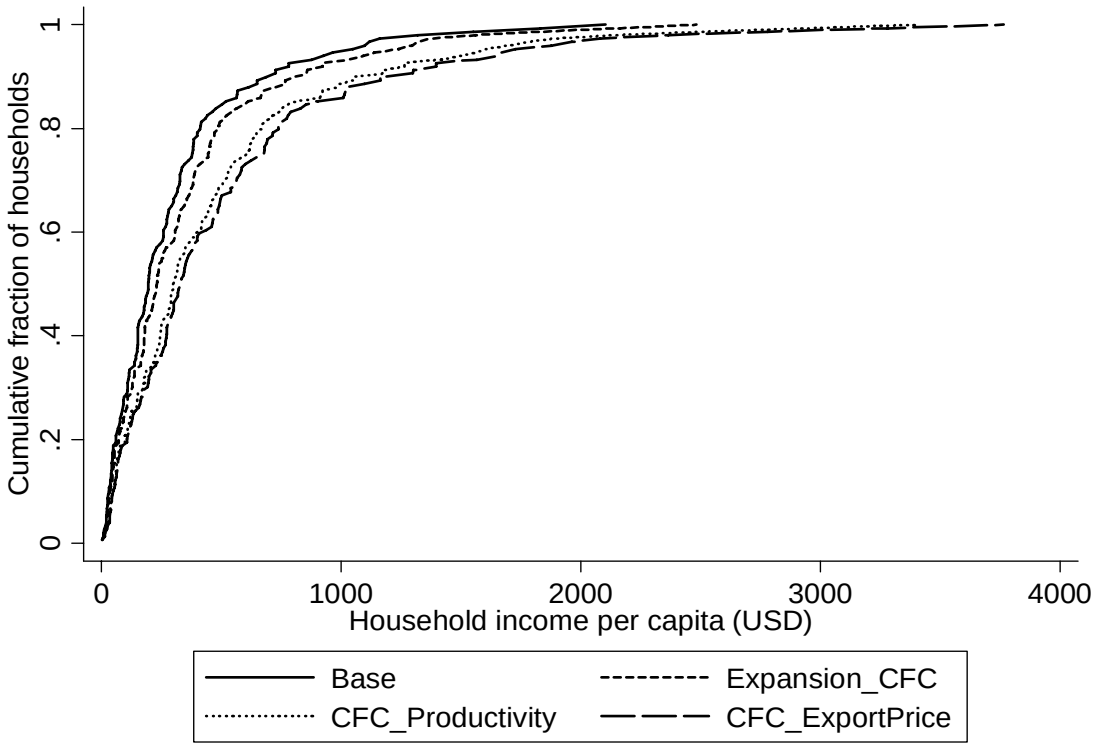
5.2. Policy Simulations in Tobacco Concession Areas

HHs in tobacco concession areas are very responsive to exogenous shocks. A 15% increase in capital specific to tobacco leads to an increase of approximately 18% in the income of both HH groups. If that injection is accompanied by an increase in the productivity of the resources used in tobacco growing activities, both groups benefit significantly, with average income of growers increasing 62%, against 43% among non-growers.[33] Figures 25 through 27 present the CDFs for those simulations.

Figures 25 through 27 present the CDFs for those simulations for all HHs in tobacco areas, and for growers and non-growers, respectively, based on the results in Table 15 and averages across all HHs.

[33] Expansion with higher tobacco world prices results in considerably higher growth rates, 49% in per capita income of non-growers and 79% in the income of tobacco growers.

Figure 25. Comparison of Poverty Effects of Simulations, Tobacco Areas Expansion, Productivity, and Export Price

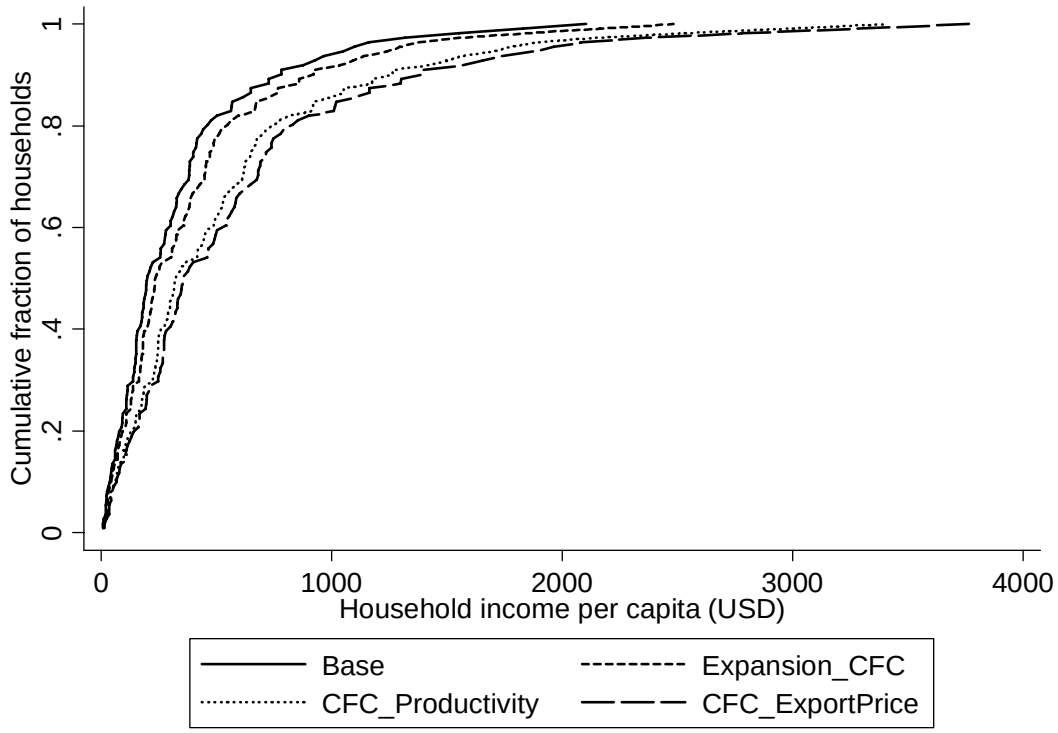


Source: Base year Zambezi Valley Study Survey data ZVR-CGE model simulations

An evaluation of the mechanisms through which these effects take effect can be better understood, by stepping back to: a) the flow diagram presented in Figure 1 that represents the generation of value added by economic activities, its remuneration to HHs based the structure of factor ownership in the base year and HH consumption patterns; and b) the structure of the economy in the base year represented in SAM and illustrated in section 4. This section used key results to illustrate the mechanisms in tobacco growing areas.

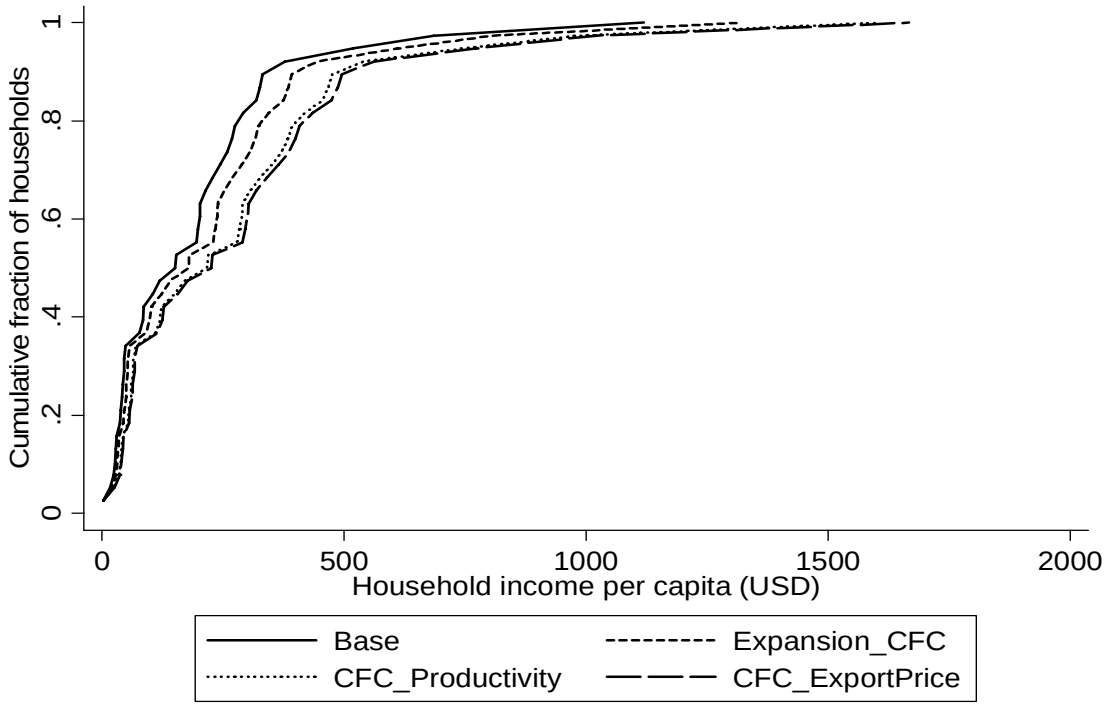
Model results indicate that initial growth generated in the tobacco sector generates growth in the level of economic activity across all sectors. Table 16 presents the structure of the level of economic activity in the base, and the changes in economic activity by simulation.

Figure 26. Comparison of Poverty Effects of Simulations, Tobacco Growers Expansion, Productivity, and Export Price



Source: Base year Zambezi Valley Study Survey data ZVR-CGE model simulations

Figure 27. Comparison of Poverty Effects of Simulations, Tobacco Non-growers Expansion, Productivity, and Export Price



Source: Base year Zambezi Valley Study Survey data ZVR-CGE model simulations

Table 16. Base Shares and Changes in the Level of Activity by Simulation in Tobacco Areas

Economic Activities	Base Activity Level (%)	Changes in Economic Activity by Simulation				
		Expansion Only	Expansion with Productivity	Expansion with Export Price	Expansion with Input Price	Expansion with Export Tax
Tobacco farms – MLT	35.1	15.8	47.6	31.5	9.3	4.1
Tobacco farms – DIMON	10.0	15.4	46.6	30.4	9.7	1.3
Non-tobacco farms	14.7	15.9	42.2	49.1	6.6	10.3
Livestock	5.1	16.7	47.5	50.4	7.4	7.6
Fishing	3.6	18.0	53.2	60.3	7.3	7.2
Food processing	1.5	17.7	52.6	57.4	7.0	6.9
Beverage processing	0.9	8.5	26.8	27.6	9.3	10.0
Other processing	1.9	18.1	55.2	65.1	6.4	6.9
MLT–marketing/export	12.4	15.8	47.6	31.5	9.3	4.1
DIMON–marketing/export	4.8	15.4	46.6	30.4	9.7	1.3
Trading services	5.0	15.6	47.6	43.7	8.5	5.2
Government services	1.4	18.1	54.7	66.0	6.9	7.2
Other services	3.6	18.0	53.1	62.0	6.6	7.4
Total	100.0					

Source: Base year Zambezi Valley Study Survey data ZVR-CGE model simulations

Results in the table show that while agricultural activities, particularly tobacco growing and its associated value adding, dominate in terms of the base structure, growth in economic activity in other activities is also substantial. For example, expansion with productivity results in about 47% growth in the level of economic activity in tobacco activities, 42% in other agricultural (non-tobacco) activities, and of over 47% in almost all non-farming activities, including processing and services.

The relatively higher level of economic activity results in greater remunerations for grower and non-grower groups alike, via the increased demand of factors by the activities. For example, in the case of expansion with productivity increases, Table 17 shows that tobacco growing activities increase their use of factors by about 30%, while other non-growing farming activities expand even further, about 42%.[34] Demand for labor by non-agricultural activities also expands dramatically. For example, livestock, fishing, food processing, other manufacturing, and trade, increase their demand for labor resources by an average of over 50%. These increases are a result of consumption linkages in the economy, as HHs demand additional goods and services with the increased income.

[34] Note that the increase in demand for factors between MLT and DIMON-Mozambique is approximately the same—30.9% and 29.7%, respectively, but the MLT base scenario demand level is much higher.

Table 17. Changes in Demand for Factors from Activities in Tobacco Areas

	% Change in Demand for Factors by Simulation				
Economic Activities	Expansion Only	Expansion with Productivity	Expansion with Export Price	Expansion with Input Price	Expansion with Export Tax
Tobacco farms – MLT	15.9	30.8	35.2	8.9	3.5
Tobacco farms - DIMON	15.4	29.7	33.6	9.3	0.6
Non-tobacco farms	15.9	42.2	49.1	6.6	10.3
Livestock	16.7	47.5	50.4	7.4	7.6
Fishing	18.0	53.2	60.3	7.3	7.2
Food processing	17.7	52.6	57.4	7.0	6.9
Beverage processing	8.5	26.8	27.6	9.3	10.0
Other processing	18.1	55.2	65.1	6.4	6.9
MLT–marketing/export	15.8	47.6	31.5	9.3	4.1
DIMON–marketing/export	15.4	46.6	30.4	9.7	1.3
Trading services	15.6	47.6	43.7	8.5	5.2
Government services	18.1	54.7	66.0	7.0	7.2
Other services	18.0	53.1	62.0	6.6	7.4

Source: Base year ZVR-SAM and ZVR-CGE model simulations

The actual magnitude of these impacts depends on the structure of factor use by economic activity, presented in Table 18 (that determines the actual change in the quantity used by each activity). As expected, tobacco growing activities demand the greatest share of all factors: over three-quarters of the land, close to 50% of the pre-harvesting family labor, a quarter of the harvesting and post-harvesting family labor, over 50% of the waged labor throughout the season, and about 45% of the capital. Demand for family and waged labor by non-agricultural activities is higher in the post-harvesting season, when labor is released from agricultural tasks.

Table 18. Base Factor Use Shares by Activity in Tobacco Areas

	Use of Production Factors (Allocation across Activities) ---- % of Total Base Year ----					
Economic Activities	Land	Family Labor Pre-harvest	Family Labor Post-harvest	Wage Pre-harvest	Wage Post-harvest	Capital
Tobacco farms – MLT	60.9	36.1	17.8	44.3	46.5	35.8
Tobacco farms - DIMON	15.4	12.7	6.2	13.2	8.8	10.2
Non-tobacco farms	23.7	18.3	10.1	27.5	12.5	17.2
Livestock	0.0	12.2	15.5	1.0	2.9	0.0
Fishing	0.0	7.6	12.4	2.0	3.7	10.0
Food processing	0.0	1.4	3.1	2.0	0.2	1.1
Beverage processing	0.0	2.1	4.7	0.0	0.1	1.1
Other processing	0.0	4.3	9.3	0.2	1.0	4.8
MLT–marketing/export	0.0	0.0	0.8	0.4	1.3	1.7
DIMON-marketing/export	0.0	0.0	0.8	0.2	0.7	0.5
Trading services	0.0	1.3	3.1	4.1	10.3	15.1
Government services	0.0	0.0	0.8	4.1	8.1	0.0
Other services	0.0	4.0	15.5	1.0	3.7	2.4
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: ZVR-CGE model simulations

With the expansion and productivity increase, for example, additional factor income (Table 19), i.e., the value of the quantity of factors (land labor and capital) at market clearing wages/rents, generated in this process is substantial. Remuneration to land increases about 33%, while that for family labor increases 42% on average (39% for pre-harvesting labor and 44% for harvesting and post-harvesting), and for wage labor increases 55% on average (52% for pre-harvesting labor and 58% for harvesting and post-harvesting). Returns to activity specific capital are significantly high in the presence of productivity increases and increases in export prices. While increases in the remunerations to activity specific capital as a result of a 15% injection, *ceteris paribus*, are only 22%, a compounded shock with a simultaneous 15% gain in productivity generates an average increase of 300%. Since this capital is specific to grower HHs, the direct implications are exactly on that group. The non-grower group also benefits substantially from this, but only indirectly through the remuneration to other factors. As noted in earlier sections, agricultural and non-agricultural activities in those areas are labor intensive, with a mix of family and wage labor. The factor income payments to each group reflect the original factor endowments in SAM, summarized in Table 19. To a great extent, this helps explain why impacts to non-grower groups are also substantial. In Table 19, we see that relative to returns to family labor, wage labor (the fastest growing factor income) is relatively more important in non-grower HHs, about 35% of total income, against only 22% among growers (percentages from base structure). In that sense, an increase in labor hiring by growers and expanding non-farm activities gets predominantly remunerated to non-grower HHs, implying that the income of those HHs increases accordingly.

It is worth noting that any expansion with or without productivity gains or price increases is very compensating for non-grower groups. For instance, results indicate that a simple expansion of 15% in the tobacco sector generates a 17.8% increase in non-grower income (all reflected as indirect effects), and only 18.1% among growers (almost entirely from direct effects).

If expansion in cash cropping schemes is accompanied by negative market events, such as an increase in the price of input or a government imposed export tax on tobacco, growth of HH income slows down significantly.

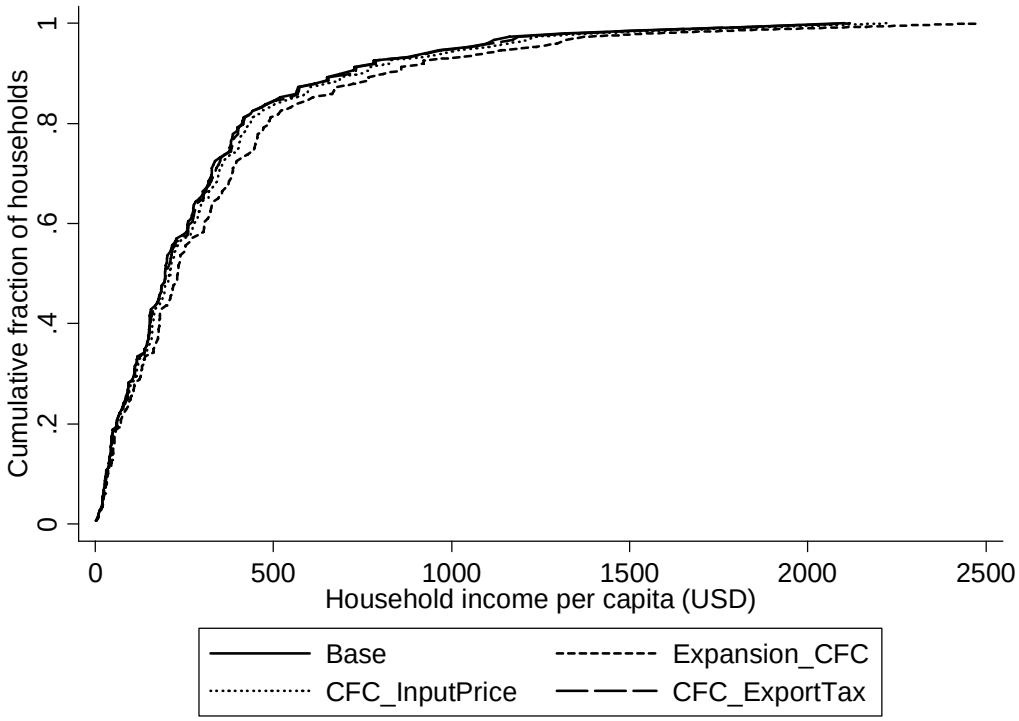
In our simulations, an expansion that is accompanied by an increase in the price of imports for production input reduces income growth from 18% (in the injection alone simulation) to 8.7% among non-growers and only 5.6% among growers that get directly hit. This is illustrated in Figures 28 through 30 by distribution curves that just slightly dominate the base, which means a higher poverty incidence, at all the relevant poverty lines, relative to other simulations. Figure 28 shows the situation for all HHs in tobacco areas, and Figures 29 and 30 present effects for growers and non-growers, respectively. The export tax has the most devastating effect among growers whose income literally stagnates as a result. These results have serious policy implications that are discussed in detail later in this paper.

Table 19. Base Shares and Changes in the Factor Remunerations by Simulation

HHs and Factors	Base Structure (%)	Changes in Factor Remunerations by Simulation				
		Expansion Only	Expansion with Productivity	Expansion with Export Price	Expansion with Input Price	Expansion with Export Tax
Tobacco HHs						
Land	32.2	15.8	33.3	38.2	8.4	4.7
Family labor, pre-harvesting	21.4	16.1	38.8	43.8	8.0	5.7
Family labor, harvesting/marketing	14.1	16.5	44.3	49.9	7.6	6.5
Wage labor, pre-harvesting	12.6	22.4	52.1	60.6	10.9	7.2
Wage labor, harvesting/marketing	9.0	24.2	58.2	66.6	11.7	7.1
Capital	3.0	16.4	47.6	50.8	7.4	7.5
Activity specific capital	7.7	22.0	300.0	440.0	-31.5	-65.0
TOTAL	100.0					
Non-tobacco HHs						
Land	18.3	15.8	33.3	38.2	8.4	4.7
Family labor, pre-harvesting	21.7	16.1	38.8	43.8	8.0	5.7
Family labor, harvesting/marketing	14.0	16.5	44.3	49.9	7.6	6.5
Wage labor, pre-harvesting	22.7	22.4	52.1	60.6	10.9	7.2
Wage labor, harvesting/marketing	12.6	24.2	58.2	66.6	11.7	7.1
Capital	10.7	16.4	47.6	50.8	7.4	7.5
TOTAL	100.0					

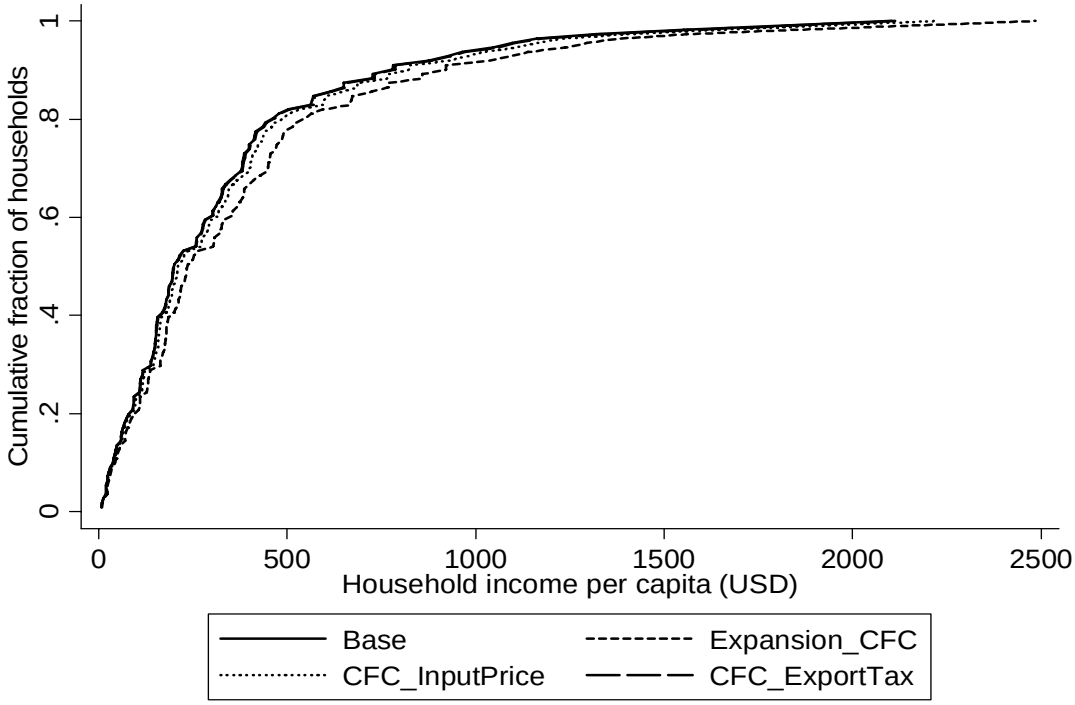
Source: Base year ZVR-SAM and ZVR-CGE model simulations

Figure 28. Comparison of Poverty Effects of Simulations, Tobacco Areas Expansion, Import Price of Inputs, and Export Tax



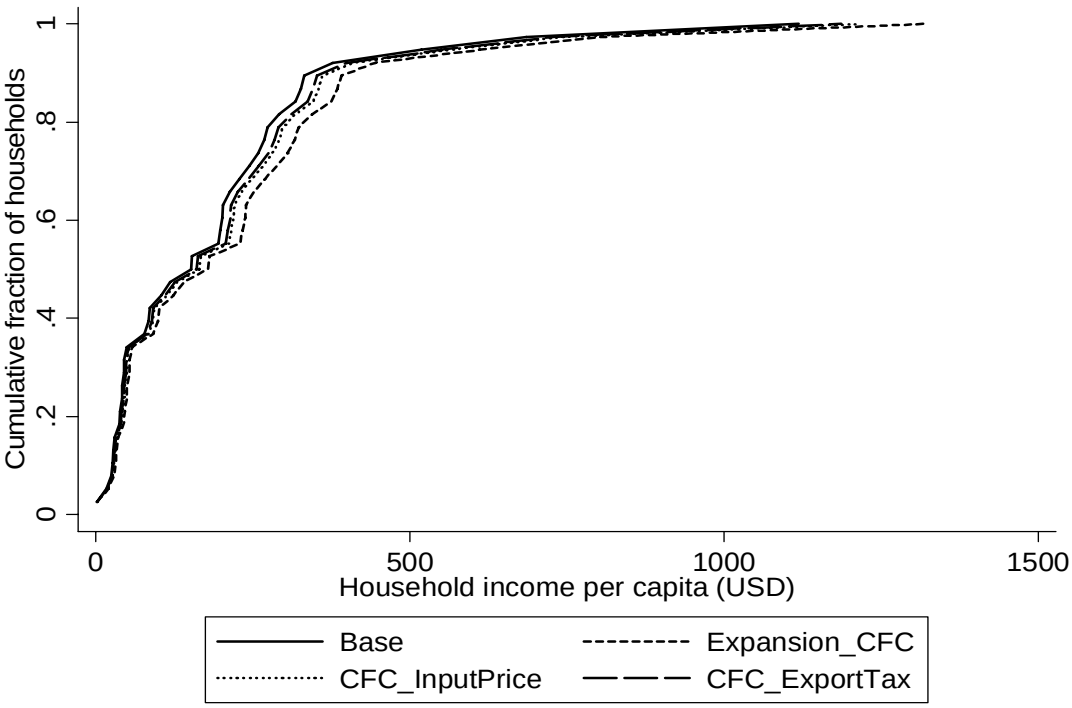
Source: Base year Zambezi Valley Study Survey data ZVR-CGE model simulations

Figure 29. Comparison of Poverty Effects of Simulations, Tobacco Growers Expansion, Import Price of Inputs, and Export Tax



Source: Base year Zambezi Valley Study Survey data ZVR-CGE model simulations

Figure 30. Comparison of Poverty Effects of Simulations, Tobacco Non-growers Expansion, Import Price of Inputs, and Export Tax



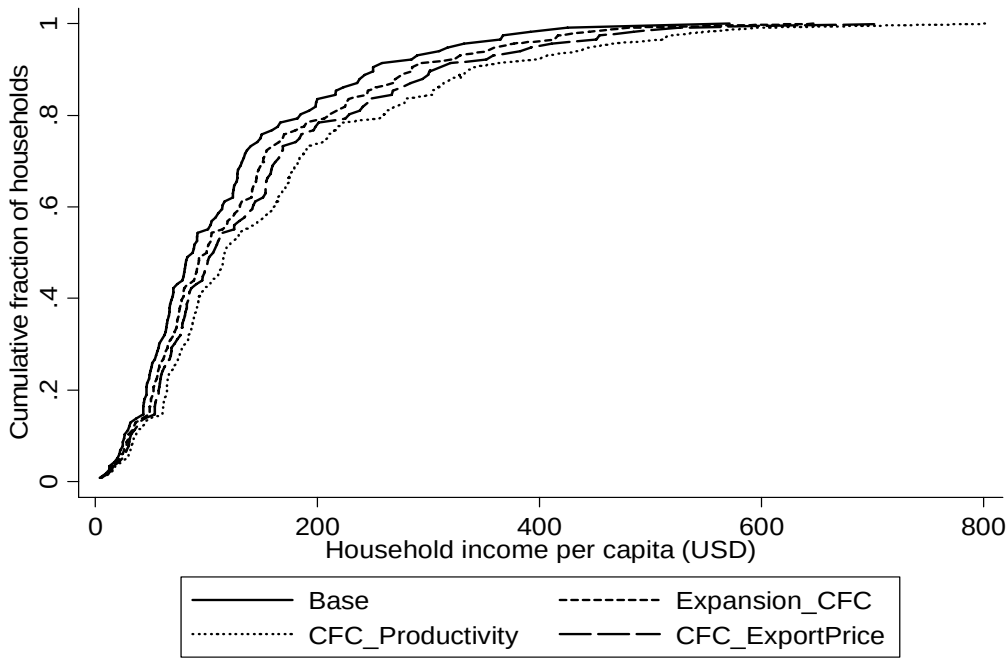
Source: Base year Zambezi Valley Study Survey data ZVR-CGE model simulations

5.3. Policy Simulations in Cotton Concession Areas

HH income levels in cotton areas are relatively less responsive to economic shocks than those in tobacco areas. A 15% injection of activity specific capital results in increases in HH income of close to 14% for both growers and non-growers. This indicates that, without changes in cotton prices and the levels of productivity, the simple expansion of cotton production schemes results in almost equivalent expansion in per capita income of grower and non-grower HHs. Note that while grower income growth is predominantly attributable to direct effects, non-grower income grows as a result of indirect effects.[35] If that expansion is accompanied by a 15% gain in cotton productivity, income growth is substantially higher, 31.2% among non-growers and 40.5% among cotton growers. An increase in the cotton export price generates income increases in the order of 20.5% among non-growers and only 23.7% among growers. Figures 31 through 33 present the comparison of poverty impact of those simulations using CDFs for all HHs and separately for growers and non-growers in cotton areas. The CDFs are directly computed using the results presented in Table 15 for cotton areas and averages across all HHs.

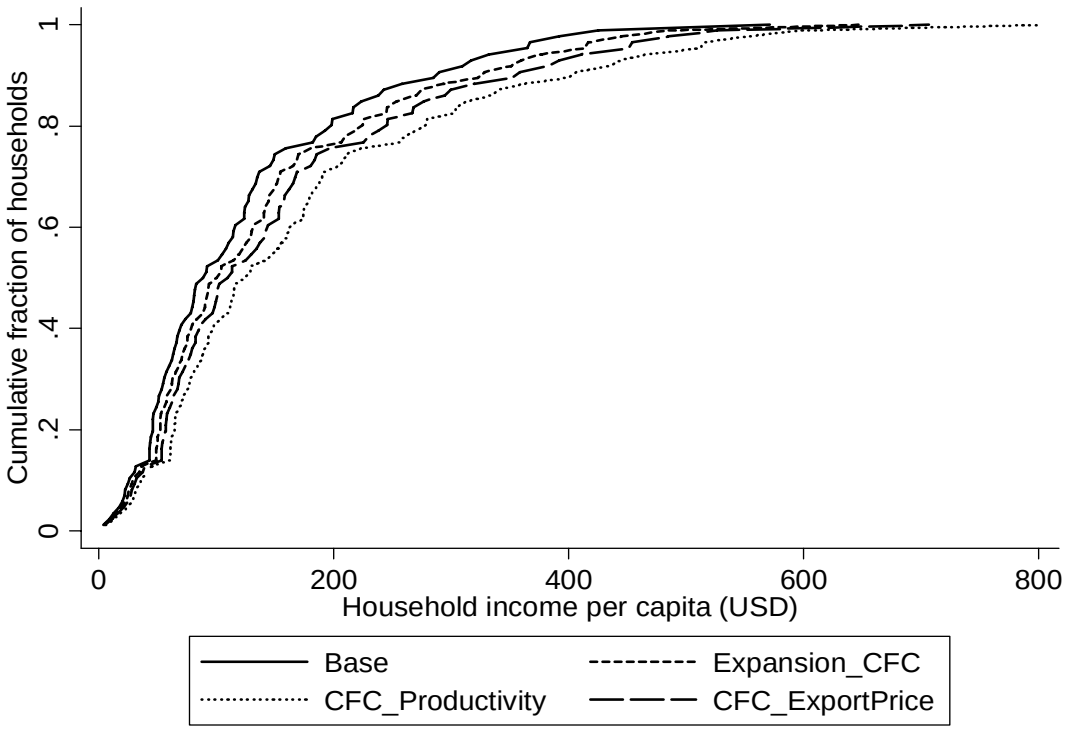
[35] Increases in income are a result of a combination of changes (positive or negative) in quantities of factors used, and also changes (positive or negative) in wages/rents of those factors resulting from the adjustment process. This income is remunerated to HHs in proportions corresponding to their original factor endowments.

Figure 31. Comparison of Poverty Effects of Simulations, Cotton Areas Expansion, Productivity, and Export Price



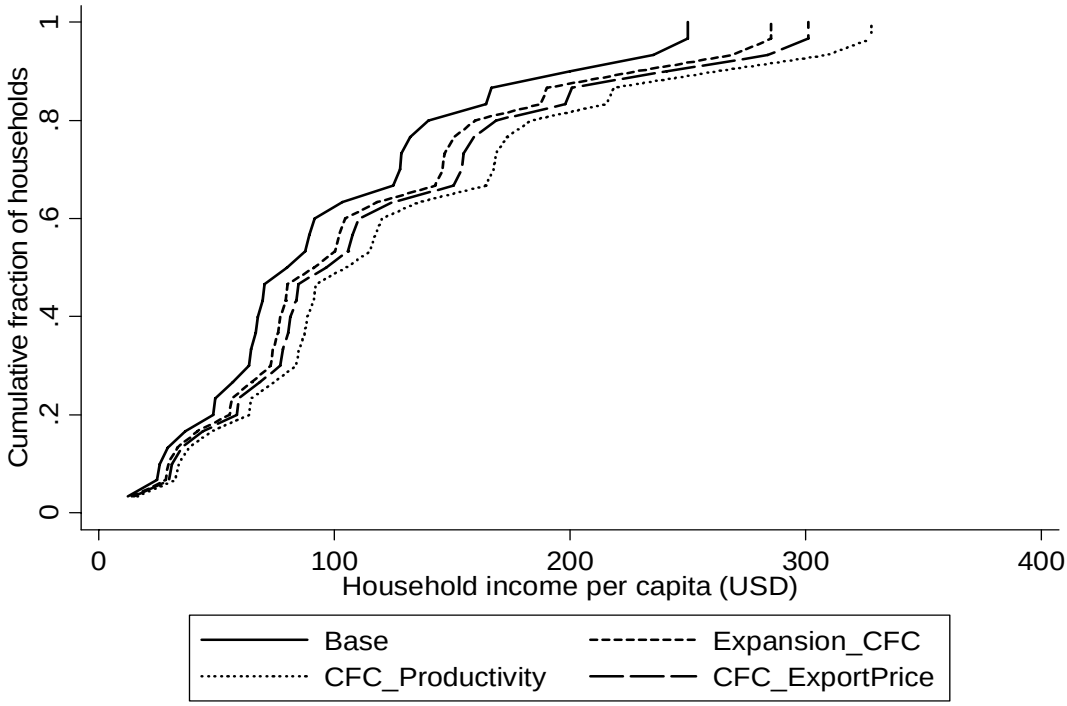
Source: Base year Zambezi Valley Study Survey data ZVR-CGE model simulations

Figure 32. Comparison of Poverty Effects of Simulations, Cotton Growers Expansion, Productivity, and Export Price



Source: Base year Zambezi Valley Study Survey data ZVR-CGE model simulations

Figure 33. Comparison of Poverty Effects of Simulations, Cotton Non-growers Expansion, Productivity, and Export Price



Source: Base year Zambezi Valley Study Survey data ZVR-CGE model simulations

As expected, all these expansions generate additional demand for goods and services proportional to the increases in income for each group, but with variation across the different items reflecting HH consumption demand patterns. Like in tobacco areas, we observed an expansion in the level of economic activity in all sectors. For example, in the case of expansion with productivity gains, direct increases in the level of activity of production and value-adding activities in cotton (averaging 44%) are higher than increases in the level of activity of other sectors, such as non-cash cropping agriculture (32%), livestock, fishing, food processing, manufacturing, and services, that range from 34% to 37%. These impacts are detailed in Table 20, along with results for other simulations. The table also shows the base period shares in economic activity.

In spite of that, the quantity of factors demanded from the cash cropping activities is weaker in percentage terms relative to the demand generated in other sectors. In fact, Table 21 shows that the quantity demanded of factors by activities with the productivity enhancing path results in an average increase in factor demand from cash cropping activities of about 26%, (27% among C.N.A. farmers and 26% among DUNAVANT-Mozambique farmers). Note that C.N.A. operations are significantly larger in the base year, which results is a larger absorption of resources in absolute terms. Demand for factors among non-cash cropping farming activities increases 32.4%, while among all non-farming activities it grows 32% to 38%. In contrast, an expansion without productivity gains, but with an increase in cotton export prices, only results in increases in factors demand of 20% to 22%, across all economic activities. Table 22 shows how factors are allocated across the different activities in the base period.

Table 20. Base Shares and Changes in the Level of Activity in Cotton Areas

Economic Activities	Base Activity Level (%)	Changes in Economic Activity by Simulation				
		Expansion Only	Expansion with Productivity	Expansion with Export Price	Expansion with Input Price	Expansion with Export Tax
Cotton farms – C.N.A.	24.6	14.6	44.7	20.2	13.7	10.1
Cotton farms – DUNAVANT	3.7	14.5	42.7	19.7	13.6	11.1
Non-cotton farms	33.9	14.7	32.4	21.3	13.2	12.8
Livestock	7.9	14.6	35.2	21.4	13.2	12.1
Fishing	5.6	14.5	35.7	22.1	13.0	11.8
Food processing	2.2	14.5	36.6	21.4	13.1	11.8
Beverage processing	1.4	16.0	34.1	15.5	15.4	14.4
Other processing	2.7	14.4	36.4	22.2	12.9	11.6
C.N.A./marketing/export	4.5	14.6	44.7	20.2	13.7	10.1
DUNAVANT/marketing/export	0.5	14.5	42.7	19.7	13.6	11.1
Trading services	5.0	14.9	37.9	20.1	13.7	11.9
Government services	2.4	14.4	36.2	22.4	12.9	11.6
Other services	5.4	14.5	35.6	22.1	12.9	11.8
Total	100.0					

Source: Base year ZVR-SAM and ZVR-CGE model simulations

Table 21. Changes in Demand for Factors from Activities in Cotton Areas

Economic Activities	% Change in Demand for Factors by Simulation				
	Expansion Only	Expansion with Productivity	Expansion with Export Price	Expansion with Input Price	Expansion with Export Tax
Cotton farms – C.N.A.	14.6	27.4	20.8	13.5	9.8
Cotton farms – DUNAVANT	14.5	25.7	20.4	13.4	10.8
Non-tobacco farms	14.7	32.4	21.3	13.2	12.8
Livestock	14.6	35.2	21.4	13.2	12.1
Fishing	14.5	35.7	22.1	13.0	11.8
Food processing	14.6	36.6	21.4	13.1	11.8
Beverage processing	16.0	34.1	15.5	15.4	14.4
Other processing	14.4	36.4	22.2	12.9	11.6
C.N.A./marketing/export	14.6	44.7	20.2	13.7	10.1
DUNAVANT/marketing/export	14.5	42.7	19.7	13.6	11.1
Trading services	14.9	37.9	20.1	13.7	11.9
Government services	14.4	36.2	22.4	12.9	11.6
Other services	14.5	35.6	22.1	12.9	11.8

Source: Base year ZVR-SAM and ZVR-CGE model simulations

The resulting changes in factor remunerations (additional value of factor payments at market wage/rents), under the productivity gain path, are fairly balanced reflecting variations in wages/rents. Remuneration to land increases about 30%, while that for family labor increases 33% on average (31% for pre-harvesting labor and 33% for harvesting and post-harvesting), and for wage labor increases 32% on average (33% for pre-harvesting labor and 31% for

Table 22. Base Factor Use Shares by Activity in Cotton Areas

Economic Activities	Land	Family Labor Pre-harvest	Family Labor Post-harvest	Wage Pre-harvest	Wage Post-harvest	Capital
	Use of Production Factors (Allocation across Activities) ---- % of Total Base Year ----					
Cotton farms – C.N.A.	37.9	23.1	23.8	13.4	46.6	20.4
Cotton farms – DUNAVANT	4.9	4.8	2.0	4.4	3.9	4.2
Non-cotton farms	57.2	41.1	19.0	41.5	15.8	44.9
Livestock	0.0	11.3	12.9	3.9	3.3	0.0
Fishing	0.0	7.4	11.5	6.6	5.0	10.7
Food processing	0.0	1.1	2.3	4.0	0.3	1.0
Beverage processing	0.0	2.0	3.7	0.0	0.1	0.7
Other processing	0.0	4.1	7.9	0.7	1.3	4.8
C.N.A./marketing/export	0.0	0.0	0.0	0.3	0.8	0.8
DUNAVANT/marketing/export	0.0	0.0	0.0	0.0	0.1	0.1
Trading services	0.0	1.1	2.6	9.1	8.6	10.0
Government services	0.0	0.0	0.0	13.1	9.9	0.0
Other services	0.0	3.9	14.3	2.9	4.4	2.4
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: ZVR-CGE model simulations

harvesting and post-harvesting). Returns to activity specific capital average 200%, reverting exclusively to grower groups (see Table 23). While land is evenly distributed, non-growers, as the most populous group, have most of the labor available in the economy, and benefit from wage labor, particularly in the first part of the season (pre-harvesting) when it supplies over half of the wage labor. In the post-harvesting, the initial employment between the two groups is quite similar with each group supplying about half of the labor.

This is a clear indication that productivity increases in cotton production allow for good prospects for expansion, not only in the sector itself, but also in other sectors of the economy where resources can be productively employed, which leads to greater possibilities for increases in HH income irrespective of cash cropping status. As pointed out in the beginning of this section, any expansion in cotton production results in some indirect employment effects to non-growers, even when benefits to growers are limited.

A somewhat surprising result in cotton areas is that, although slowing growth, the effects of adverse circumstances are less severe than in tobacco areas, although, as indicated in the figures for both groups, poverty is more severe as compared to other scenarios. In fact, an increase in input import prices during expansion reduces income growth from 14% to an average of 13% among non-growers and 12% among growers. It is clear that scenario still dominates the base, indicating that poverty reduction occurs, but its magnitude is insignificant. A possible justification for this is that the input package in cotton areas is much cheaper than that in tobacco areas. On that basis, one can infer that price increases of this magnitude are not enough to shake the costs of cotton growers to the extent of impacting poverty significantly. The export tax has also a relatively small impact on poverty, but as expected, grower HHs are relatively more negatively impacted.

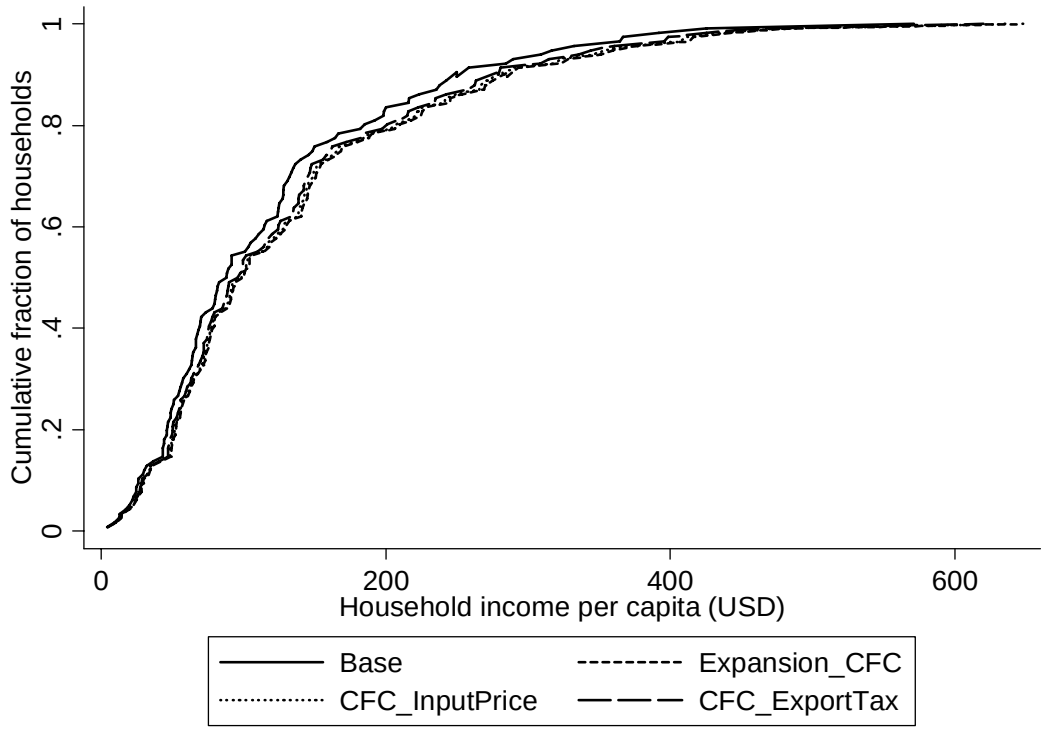
CDFs of the comparison of effects of the various simulations are presented for all HHs in cotton areas (Figure 34), as well as for growers (Figure 35) and non-growers (Figure 36).

Table 23. Base Shares and Changes in the Factor Remunerations, by Simulation

HHs and Factors	Base Structure (%)	Changes in Factor Remunerations by Simulation				
		Expansion Only	Expansion with Productivity	Expansion with Export Price	Expansion with Input Price	Expansion with Export Tax
Cotton HHs						
Land	27.2	14.7	30.2	21.1	13.3	11.6
Family labor, pre-harvesting	25.4	14.7	31.9	21.1	13.3	11.8
Family labor, harvesting/marketing	13.9	14.6	32.9	21.2	13.3	11.6
Wage labor, pre-harvesting	11.0	14.6	33.1	21.3	13.2	11.9
Wage labor, harvesting/marketing	14.5	14.6	31.3	21.1	13.3	11.0
Capital	1.7	14.7	34.2	21.2	13.2	12.4
Activity specific capital	6.4	10.5	200.0	85.0	0.75	-24.0
TOTAL	100.0					
Non-cotton HHs						
Land	18.2	14.7	30.2	21.1	13.3	11.6
Family labor, pre-harvesting	29.5	14.7	31.9	21.1	13.3	11.8
Family labor, harvesting/marketing	16.8	14.6	32.9	21.2	13.3	11.6
Wage labor, pre-harvesting	13.4	14.6	33.1	21.3	13.2	11.9
Wage labor, harvesting/marketing	9.8	14.6	31.3	21.1	13.3	11.0
Capital	12.3	14.7	34.2	21.2	13.2	12.4
TOTAL	100.0					

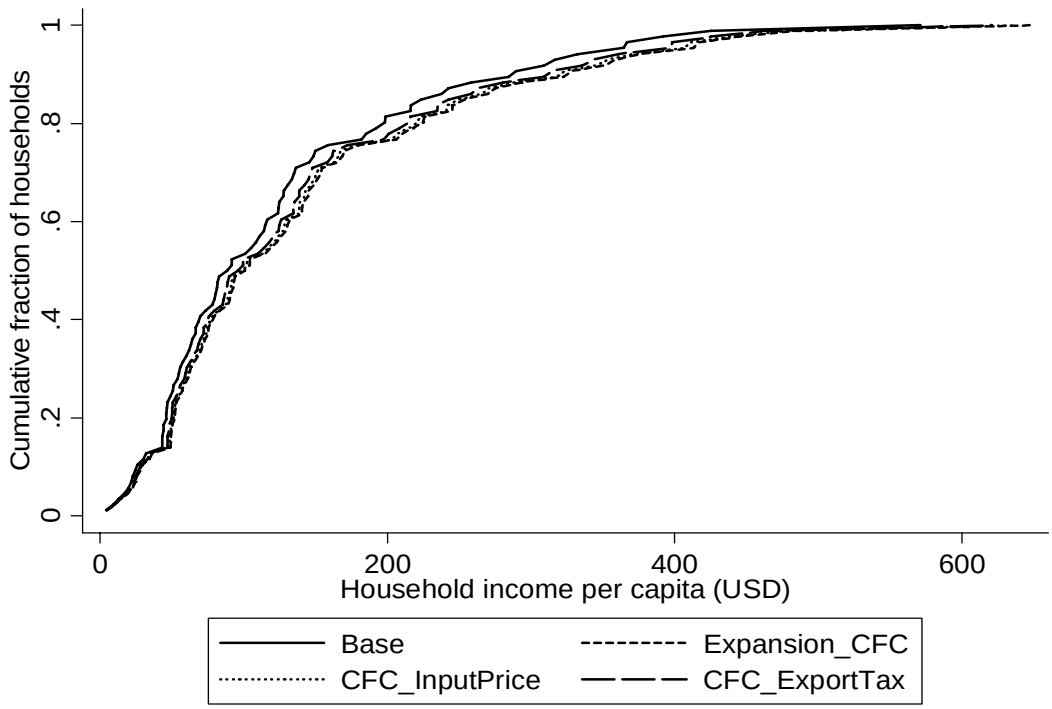
Source: Base year ZVR-SAM and ZVR-CGE model simulations

Figure 34. Comparison of Poverty Effects of Simulations, Cotton Areas Expansion, Import Price of Inputs, and Export Tax



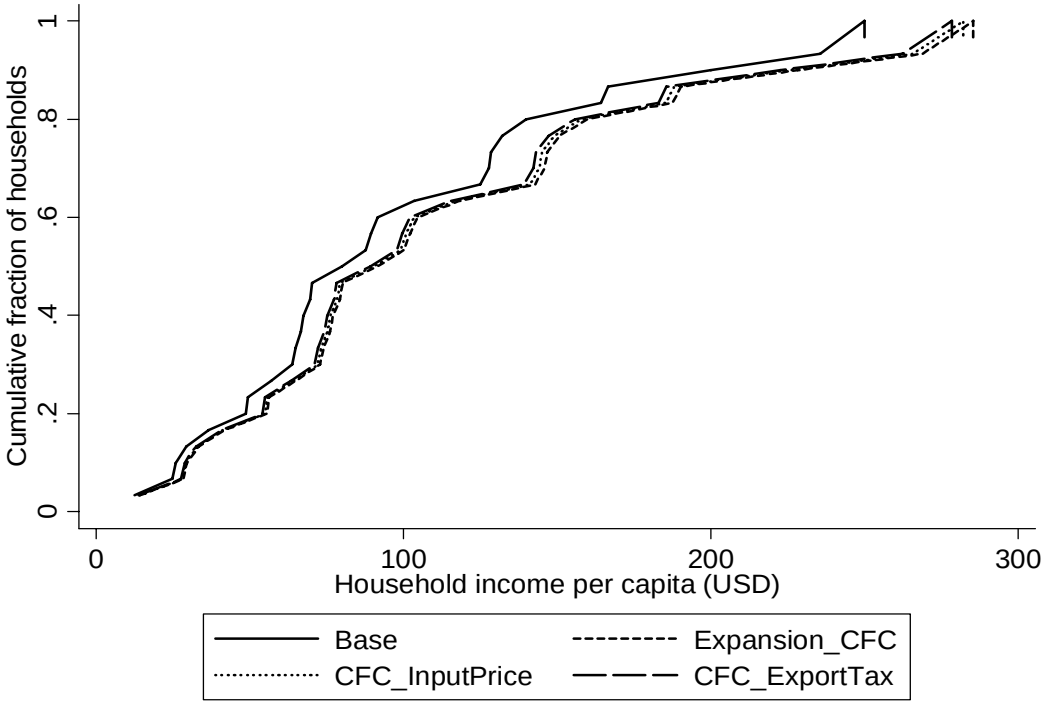
Source: Base year Zambezi Valley Study Survey data ZVR-CGE model simulations

Figure 35. Comparison of Poverty Effects of Simulations, Cotton Growers Expansion, Import Price of Inputs, and Export Tax



Source: Base year Zambezi Valley Study Survey data ZVR-CGE model simulations

Figure 36. Comparison of Poverty Effects of Simulations, Cotton Non-growers Expansion, Import Price of Inputs, and Export Tax



Source: Base year Zambezi Valley Study Survey data ZVR-CGE model simulations

6. SUMMARY OF POLICY IMPLICATIONS

A fundamental question in this paper is related to the extent to which strategies that rely on indirect effects can effectively be used to target rural poverty. In other words, can shocks to cash cropping sectors generate broad-based income growth and poverty reduction effects? If so, how strong are those indirect benefits? This issue is addressed through the analysis of the poverty impact of selected policy simulations—favorable and unfavorable shocks occurring concomitantly to expansion of CF schemes in cash cropping economies in the Zambezi Valley of Mozambique. Such shocks include technology shifts, trade issues including increases in prices of imported input, changes in export prices of maize, cotton, and tobacco, and government export taxes.

In tobacco growing areas, expansion in the sector spreads growth to virtually all sectors of activity, including non-cash cropping agriculture and non-farming activities, such as manufacturing and services. These growth results in greater remunerations for grower and non-grower HHs via the increased demand of factors by those activities. The analysis suggests that in these areas, the benefits of expansion with higher tobacco prices have a very important poverty reduction impact, particularly among cash crop growers, even when productivity is assumed unchanged. However, a more balanced growth in income of growers and non-growers is obtained when productivity among growers increases. Increases in import prices of input and government imposed taxes on tobacco exports significantly slow down income growth in rural areas, particularly among grower HHs. Since export price increases are uncertain and almost as likely to occur as reductions, a productivity increasing effort is worth pursuing in tobacco areas to compensate for any losses resulting from exogenous factors, including increases in import prices of chemical input and seeds, and even reductions in export prices. Associated interventions can include strengthening of extension systems to ensure the use of proper techniques/field practices, better grading, and improved environmental management. Regarding foreign trade policy, the findings suggest that the government needs to avoid the use of trade restrictions, such as export taxes, as they may undermine poverty reduction efforts by significantly slowing down income growth. On the other hand, government and private businesses need to find ways to minimize the importing cost of intermediary input. While Mozambique has no power to influence world prices of imported intermediaries, any policy that prevents further cost increases and actions that can help reduce transaction cost are welcome.

In the cotton sector, several studies have emphasized low prices and poor productivity at the farm level as factors leading to the stagnation farmer income in Mozambique (World Bank 2005; Tschirley, Ofiço, and Boughton 2005). [36] This paper documents the low profitability of the crop relative to tobacco in the Zambezi Valley region. The concession model as applied in Mozambique, which precludes competition among companies and does not balance this with any effective performance monitoring system, must be considered an important contributor to the problem of low prices and also low productivity (Tschirley, Poulton, and Boughton 2006; Poulton et al. 2004). Management subjected to little or no competitive discipline will be able to transfer inefficiency costs to farmers through low prices.

[36] In fact, Mozambique pays the lowest prices in the region; the 1998-2002 average producer prices were $0.16 per kilogram, compared to $0.22 in Zambia and Tanzania and $0.25 in Zimbabwe (Poulton et al. 2004). Likewise, yields are among the lowest in Africa: 0.51 tons per ha in 2003/4, compared to 0.9 tons in Zimbabwe and over 1.0 ton in West Africa (Lemaitre, Fok, and Jeje 2001). Tschirley, Poulton, and Boughton (2006) assess the impact of the sector's regulatory structure on this performance.

Simulation results indicate that, although limited when compared to tobacco areas, expansion in the cotton sector, even when benefits to growers are small, generates some expansion in non-cotton sectors where resources are productively employed. When that expansion is accompanied by productivity gains in cotton, there is a much stronger broad-based income growth and poverty reduction effect, even greater than increased world prices. From a policy standpoint, because sustained increases in world prices are unlikely, this result is encouraging. All this suggests that continued expansion efforts in cotton focused on dealing with institutional issues and productivity enhancing technologies, as they succeed, will increase those benefits significantly. Interventions to improve the business environment for the emergence and sustained growth of non-farm businesses are also important to fuel further growth.

Last, a set of additional policy considerations are worth pointing out. We found that in both areas, HHs are heavily engaged in maize production and trade, and can benefit substantially from high export prices.[37] Benefits are more sizable among cash crop growers, but poverty reduction among non-growers is also remarkable. While high export prices of maize are desirable, they are outside the control of the government and individual producers and traders. The important policy implication here is that the government needs to allow a continued flow of maize between locations inside Mozambique and exports to neighboring countries, such as Malawi and Zimbabwe, when those countries are faced with cereal deficits.[38] Given the limited effective demand inside Mozambique, and the high unit transportation costs in that domestic trade, this is a good opportunity that can help reduce poverty in rural communities on a broad-based fashion, especially at times when prices are high. In this line, it is suggested that CF schemes in both areas include improved maize seeds, and productivity enhancing technologies to increase maize yields and maximize these potential impacts. In addition to income poverty reduction, improved maize yields also have important implications for HH food security in those areas.

Finally, it is important to emphasize the need for complementary research in key aspects that fall outside the scope of this paper, but are crucial for the advancement of the sectors and for their sustained positive impact on broad-based income growth and poverty reduction. We suggested that strategies which emphasize improved coordination for facilitating investments in research and extension combined with area expansion, increased productivity, and quality at the farm level, should be identified and encouraged.[39] Research should continue to focus on the analysis of the implications of the current market and regulatory structure for competition and sector coordination, and suggest ways to overcome current constraints to maximize the effects of interventions on rural poverty.

[37] Note that the notion of trade here includes both exports to the domestic (other parts of Mozambique) and foreign (neighboring countries) RoW.

[38] Episodes of trade restrictions, particularly in border areas, have been more common as local practice than as an official central government policy; the latter is openly favorable to free trade. It is, therefore, important that the government be more active in ensuring that local authorities do not prohibit maize trade.

[39] That can be achieved with high yielding quality seeds, the strengthening of extension systems for disseminating good field practices and grading standards, and sufficiently remunerative producer prices to ensure a continued and increasing participation of farmers in the sectors.

APPENDIX A

SAM MULTIPLIER ANALYSIS

The SAM based multiplier model evaluates the effects of exogenous income injections (shocks) on the endogenous accounts as a result of policy or program changes (Pyatt and Round 1979; Pyatt and Round 1985; Parikh and Thorbecke 1996).

A balanced SAM requires, that for each account, income equals expenditures, i.e.,

$$\sum_j T_{kj} = \sum_j T_{ik} \qquad \text{(A.1)}$$

where k refers to a given row I and column j corresponding to the same SAM account.

Formally, for a SAM multiplier analysis, the SAM transactions matrix, T, is converted into a matrix of average shares (or average expenditure propensities), A_n,[40] by dividing the cells in each row ($T_{i,j}$) by the column sums (y_j):

$$A_{i,j} = T_{i,j} / y_j \qquad \text{(A.2)}$$

where $\sum_i A_{i,j} = 1$, for every j.

Deleting the rows and columns for the exogenous accounts from A_n yields a sub-matrix of endogenous shares, C_n, with the entries $Cn_{i,j}$.[41] The total income can now be computed as

$$Y_n = C_n Y_n + X \qquad \text{(A.3)}$$

where X is exogenous income.

From this, it follows that

$$dY_n = C_n dY_n + dX \qquad \text{(A.4)}$$

$$dY_n = M_c dX \qquad \text{(A.5)}$$

where the square matrix $M_c = (I - C_n)^{-1}$ is the multiplier matrix, the inverse of the 'identity matrix (I) less the SAM coefficients matrix of the endogenous accounts.'

The Multiplier, M_c, contains production effects in the rows corresponding to the sectors and the income effects in the rows corresponding to factors and HHs. Consider the multiplier

[40] This shares matrix provides raw material for much economic analysis. The intermediate input coefficients in cell A_{21} correspond to the LEO input-output coefficients. The coefficients for primary factors in cell A_{31} are value added coefficients and give the factor distribution of income. Column coefficients for commodity accounts represent domestic and import shares, while those for HHs, government, and investment represent expenditure shares for these final demanders. This matrix is the base for the multiplier model explained in this section. This matrix also provides the starting point for estimating parameters of non-linear, neoclassical production functions, factor demand functions, and HH expenditure systems of the type introduced in the CGE model in the next section.

[41] Note that using average expenditure shares implies unitary expenditure elasticities, and hence the computed average expenditure propensities are constant over any incremental exogenous injection, which constitutes a major limitation. One mechanism used to relax this restriction is to incorporate marginal rather than average expenditure propensities in the C matrix prior to computing the M matrix, with the help of consumer expenditure survey data (Thorbecke and Jung 1996; Parikh and Thorbecke 1996). Lack of detailed information on HH consumption behavior in rural areas may prevent that.

matrix with entries $Mc_{i,j}$, where I represents the rows and j the columns. Since M_c is a square matrix, the number of i's and j's is the same. The effects of an injection or increase in exogenous demand for a sector—the effect of one additional dollar—is given by the entry corresponding to that sector, i.e., in the main diagonal i = j. The effect of that same dollar on the production of other sectors is found in that same column j, but in the rows I that refer to those other sectors, and can be interpreted as the production linkage effect. Total production multipliers can be estimated by summing the multiplier of all sectors ($Mc_{i,j}$) for the given j column of the impacted sector. The impact on individual HH groups can be read from the individual rows and the total effect is the sum of the individual impact—read vertically in the column corresponding to the impacted sector. Likewise, the impact of transfers to the HH groups can be inferred by reading the multipliers, in the respective column of the impacted group, for the different sectors of activity, factors, and HHs.

More generally, therefore, the change in the income of the endogenous accounts (dY_n)—a column vector—can be derived by pre-multiplying the exogenous change (dX)—a column vector—by the SAM multiplier matrix (M_c)—a square matrix. Note that this a multiplication of a matrix with a vector, and that the vector of changes has a number of rows corresponding to the number of endogenous accounts and the entries will be non-zero for the accounts that are being injected and zero for the others.

Also, there are leakages (L) in this process, i.e., part of the additional income (dY_n) will be leaked through induced demand for imports, induced government revenues or induced savings. This can be represented as $dL = BdY_n$, where B represents the leakage propensity of the economy.

Table A.1 summarizes the SAM multiplier process. Y_n is the vector of total income or expenditure of the endogenous accounts; X is the sum vector of the expenditure of the exogenous accounts; L is the column vector of the exogenous accounts, C_n is the square matrix (n.n) of average shares of the endogenous accounts; and B is the rectangular matrix (m.n) of the coefficients with exogenous accounts as rows and endogenous accounts as columns. The lower part of the table defines the important concepts.[42]

The regional multiplier matrix represents estimated total, direct and indirect effects of exogenous income injections on the endogenous accounts of the regional SAM. The regional input-output (Leontief) multiplier matrix (M^L) is one component of the M_c matrix, which captures production linkages between economic activities that take place in the region. In addition, the M_c matrix also captures expenditure linkages induced by changes in production activities through their effect on income in the region. These expenditure linkages are typically stronger than production linkages in many rural Sub-Saharan African contexts (Haggblade, Hazell, and Brown 1987; Delgado, Hopkins, and Kelly 1998). To test the relative strength of consumption linkages as opposed to production linkages, this study decomposes the sectoral value added multipliers into direct, indirect, and induced effects.[43]

[42] All the endogenous accounts have to balance at a new equilibrium. Since SAM as a whole has to balance, the sum of the exogenous accounts also have to balance.

[43] The so-called induced effect is the result of including HH income and expenditure linkages in multiplier estimation and can be taken as a measure of the strength of the consumption linkages. The direct effect is simply the value added per unit of output and the indirect effect is the residual.

Table A.1. Endogenous and Exogenous Sub-matrices

	Accounts	Endogenous 1 2 3 4	Sum	Exogenous 5 6 7	Sum	Total
1 2 3 4	Activities Commodities Factors HHs	Endogenous Transactions (C_nY_n)	N	Injections X	X	Y_n
5 6 7	Government Investment Rest of region	Leakages (B_LY_n)	L	Exogenous Transactions	t	Y_x
	Totals	Y'_n		Y'_x		

Definitions:

$M_c = (I - C_n)^{-1}$	Matrix of multipliers
dX	Vector of shocks
$dY_n = M_c dX$	Vector of impacts
$dL = BdY_n$	The leakages

Source: Adapted from Pyatt and Round 1979

This SAM based fixed-price multiplier model assumes that all the endogenous sectors have unlimited capacity to supply goods and services, i.e., an infinitely elastic supply—a Keynesian demand-driven system without resource constrains (Sadoulet and de Janvry 1995; Taylor and Adelman 1996). In order for the full multiplier effects to occur, excess capacity and unused resources must prevail so that prices do not change with changing levels of output. Such an assumption may not hold true for agricultural activities in many developing countries (Thorbecke 1998). If constraints on regional resources, such as land, labor, seeds or chemical input (e.g., as a result of market imperfections) are binding, they need to be taken into account when modeling the impact of exogenous changes. Subramanian and Sadoulet (1990) and Lewis and Thorbecke (1992) deal with the issue by imposing constraints on the production of selected sectors in the form of perfectly inelastic supply. Parikh and Thorbecke (1996), in what they call mixed multipliers, allow for the possibility of inelastic supply response beyond predetermined output levels in selected sectors.[44] The logic underlying those modified multipliers, following Parikh and Thorbecke (1996), follows. Production capacity levels are defined for sectors assumed to be constrained. While excess capacity is available in the constrained sector, the fixed-price multiplier, M_c, holds. Once the defined capacity is reached, the mixed multiplier, M_m, can be used for the remaining demand.

[44] Haggblade, Hammer, and Hazell (1991) developed a price endogenous model to compare results with standard fixed-price models (semi-input-output, input-output and economic base). The model relaxes two key simplifying assumptions of the standard multiplier models: (i) it accommodates an upward-sloping supply curve for non-tradables; and (ii) allows for substitution among inputs (without imposing any specific functional form on production) rather than insisting on a fixed-coefficient LEO production technology. They conclude that price endogeneity reduces multipliers substantially.

APPENDIX B

SELECTED OUTPUT TABLES

Table B.1. Regional MACROSAM Structure (%)

	Expenditures							
(Receipts)	Activities	Commodities	Factors	HHs	S-I	GOV	RoW	Total
Activities		74.6		66.8				
		(50.8)		(49.2)				(100.0)
Commodities	24.0	6.5		22.5	100.0	29.7	102.4	
	(35.3)	(6.5)		(24.4)	(6.4)	(1.6)	(25.9)	(100.0)
Factors	76.0							
	(100.0)							(100.0)
HHs			94.2			70.3	-2.5	
			(97.2)			(3.4)	(-0.6)	(100.0)
S-I				10.7			-20.6	
				(182.0)			(-82.0)	(100.0)
GOV							20.7	
							(100.0)	(100.0)
RoW		18.8	5.8					
		(74.4)	(25.6)					(100.0)
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	

Note: The following payments were netted out: HH to RoW, HH to GOV and RoW to factors.

Table B.2. Selected Characteristics of Zambezi Valley Smallholder HHs

	Cotton Areas					Tobacco Areas				
	Type of Farmers (mean values)		Statistical Significance of the Difference			Type of Farmers (mean values)		Statistical Significance of the Difference		
	Non-growers	Growers	t-Stat	P > | t |	LS[a]	Non-growers	Growers	t-Stat	P > | t |	LS[a]
Demographic Characteristics										
HH size	5.4	6.0	1.11	0.27		6.0	5.9	-0.35	0.73	
Female headed HHs (%)	6.7	5.7	-0.18	0.86		11.9	5.1	-1.49	0.14	
Education of the HH head (years)	3.4	2.6	-1.88	0.06		2.8	3.2	1.00	0.32	
Education of HH adults (years)	4.3	3.8	-1.10	0.27		4.0	4.5	1.05	0.29	
Age of the HH head (years)	40.4	44.3	1.46	0.15		40.5	38.5	-0.95	0.34	
Labor - adult equivalents	3.2	3.5	0.86	0.39		3.7	3.5	-0.88	0.38	
Farm Assets										
Total area (ha)	2.8	4.0	2.58	0.01	**	4.4	6.9	2.84	0.01	**
Reported value of manual tools ($US)	11.8	12.9	0.61	0.54		15.6	28.6	2.16	0.03	*
Reported value of equipment ($US)	33.4	46.8	0.97	0.33		36.9	66.6	2.58	0.01	**
Use of animal traction	6.6	5.7	-0.18	0.86		4.7	7.7	0.64	0.52	
Use of Hired Labor										
Permanent labor (% using)	3.3	9.2	1.03	0.30		31.0	71.8	4.98	0.00	**
Use of Chemical Inputs										
Fertilizer – maize	0.0	0.0	-	-		21.4	32.5	1.35	0.18	
Fertilizer – vegetables	0.0	0.0	-	-		7.1	12.0	0.86	0.39	
Income Diversification(%)										
Livestock	90.0	90.0	0.05	0.96		95.2	94.0	-0.29	0.77	
Self-employment	86.7	60.9	-2.65	0.01	**	47.6	63.2	1.77	0.08	+
Wage labor employment	40.0	33.3	-0.66	0.51		47.6	23.1	-3.01	0.00	**
HH Income ($US)										
Net HH income	692.4	872.7	1.27	0.21		1,170.8	2,060.1	2.68	0.01	**
Net agricultural income	364.5	518.2	1.50	0.14		595.5	1,572.7	3.11	0.00	**
Net HH income per capita	108.6	124.9	0.76	0.45		174.7	318.1	2.36	0.02	*
Net agricultural income per capita	65.8	86.7	1.13	0.26		98.3	274.2	3.18	0.00	**
Wage labor income	80.6	42.2	-1.24	0.22		122.3	80.8	-0.92	0.36	
Self-employment (non-agricultural)	56.0	32.1	-0.60	0.55		185.9	90.2	-1.14	0.26	
Number of Observations	30	87				42	117			

Source: Zambezi Valley Cotton and Tobacco Concession Areas Study 2004

[a] Level of significance (LS): + 10%, * 5%, ** 1%

Table B.3. Factor Shares Across Sectors of Activity

	Factors						
		Labor					
		Family Labor		Hired Labor			
Activities	Land	Pre-harvest	Harvest and Post-harvest	Pre-harvest	Harvest and Post-harvest	Capital	Total
Tobacco Farms	51.0	27.5	14.8	42.8	37.8	25.8	35.3
MLT	40.5	20.3	10.9	32.8	31.8	19.8	27.5
DIMON	10.5	7.2	3.9	10.0	6.0	6.0	7.8
Cotton Farms	14.4	12.7	10.8	4.6	16.7	9.2	11.6
C.N.A.	12.8	10.5	9.9	3.5	15.4	7.6	10.1
DUNAVANT	1.6	2.2	0.9	1.1	1.3	1.6	1.5
Non-cash Crop Farms	34.5	28.2	14.0	30.1	13.5	29.8	26.4
Non-tobacco	15.3	9.9	6.2	19.5	8.2	11.1	12.2
Non-cotton	19.2	18.3	7.8	10.6	5.3	18.7	14.2
Other Primary	0.0	18.9	16.5	5.0	7.1	10.6	10.6
Livestock	0.0	11.6	14.3	1.9	2.9	0.0	5.2
Fishing	0.0	7.3	12.2	3.1	4.2	10.6	5.4
Manufacturing	0.0	7.5	15.7	3.0	1.5	6.6	5.2
Foods	0.0	1.3	2.8	2.7	0.3	1.0	1.3
Beverages	0.0	2.0	4.1	0.0	0.1	0.7	1.1
Other	0.0	4.2	8.8	0.3	1.1	4.9	2.8
Services	0.0	5.2	18.2	13.8	21.9	16.4	10.4
Trading	0.0	1.2	3.0	6.0	9.4	14.0	4.3
Government	0.0	0.0	0.0	6.4	8.7	0.0	2.2
Other	0.0	4.0	15.2	1.4	3.8	2.4	3.9
Marketing/export of Cash Crops	0.0	0.0	0.0	0.5	1.5	1.7	0.5
MLT	0.0	0.0	0.0	0.3	0.9	1.0	0.3
DIMON	0.0	0.0	0.0	0.1	0.3	0.4	0.1
C.N.A.	0.0	0.0	0.0	0.1	0.3	0.3	0.1
DUNAVANT	0.0	0.0	0.0	0.01	0.02	0.03	0.006
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Zambezi Valley Cotton and Tobacco Concession Areas Study 2004

Table B.4. Factor Shares within Sector of Activity: Agricultural, Livestock, and Fishing Activities

	Activities							
	Tobacco Farms		Cotton Farms		Non-cash Crop Farms		Other Primary	
Factors	MLT	DIMON	C.N.A.	DUNAVANT	Non-tobacco	Non-cotton	Livestock	Fishing
Land	35.5	32.6	30.5	25.6	30.1	32.6	0.0	0.0
Labor	57.4	59.8	62.0	64.1	61.0	54.4	100.0	80.8
Family	22.2	27.9	36.7	40.0	25.2	36.7	86.9	61.0
Pre-harvest	16.7	21.0	23.3	32.2	18.3	29.1	49.6	30.1
Harvest/post-harvest	5.5	6.9	13.4	7.8	6.9	7.6	37.3	30.9
Hired	35.2	31.9	25.3	24.1	35.8	17.7	13.0	19.8
Pre-harvest	20.4	22.0	5.9	13.0	27.3	12.9	6.1	9.9
Harvest/post-harvest	14.8	9.9	19.4	11.1	8.5	4.8	6.9	9.9
Capital	7.1	7.6	7.4	10.3	8.9	13.1	0.0	19.2
All Factors	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Zambezi Valley Cotton and Tobacco Concession Areas Study 2004

Table B.5. Factor Shares within Sector of Activity: Agricultural, Livestock, and Fishing Activities

Factors	Activities					
	Manufacturing			Services		
	Foods	Beverages	Other	Trading	Government	Other
Land	0.0	0.0	0.0	0.0	0.0	0.0
Labor	92.4	94.0	93.0	67.7	100.0	94.1
Family	53.3	93.2	75.9	16.2	0.0	75.8
Pre-harvest	22.8	41.7	33.3	6.5	0.0	22.7
Harvest/Post-harvest	30.5	51.5	42.6	9.7	0.0	53.1
Hired	39.1	0.8	7.1	51.5	100.0	18.3
Pre-harvest	36.5	0.2	2.1	23.7	49.8	6.0
Harvest/post-harvest	2.6	0.6	5.0	27.8	50.2	12.3
Capital	7.6	6.0	17.0	32.3	0.0	5.9
All Factors	100.0	100.0	100.0	100.0	100.0	100.0

Source: Zambezi Valley Cotton and Tobacco Concession Areas Study 2004

Note: Trading and export activities engaged in CF were assumed with: (1) no family labor; (2) hired pre-harvest: 18.0%; (3) hire harvest and post-harvest: 43.0%; and (4) capital: 38.5%

Table B.6. Factor Income Distribution across HH Types

Activities	Factors						Transfers		Total
	Land	Pre-harvest	Harvest and Post-harvest	Pre-harvest	Harvest and Post-harvest	Capital	GOV	RoW	
Cotton Growing Areas	32.5	45.3	41.7	33.8	42.7	37.5	51.3	2.1	39.3
Non-growers	16.2	28.7	26.7	21.8	21.2	24.7	20.1	0.3	23.0
Growers	16.3	16.6	15.0	12.0	21.5	12.8	31.2	1.8	16.3
Tobacco Growing Areas	67.5	54.7	58.3	66.2	57.3	62.6	48.7	97.8	60.6
Non-growers	14.3	17.9	18.7	30.5	22.9	17.8	32.1	30.0	19.8
Growers	53.2	36.8	39.6	35.7	34.4	44.8	16.6	67.8	40.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Computed from the ZVR-SAM 2003/4 and survey data

Table B.7. Shares of Factors and Transfers in HH Income (%)

Factors and Net Transfers from GOV and RoW	Shares of Factors and Transfers in HH Income (%)				
	Cotton Area HHs		Tobacco Area HHs		All HHs
	Non-growers	Growers	Non-growers	Growers	
Land	17.5	24.7	17.8	32.4	24.8
Labor	68.7	60.9	68.4	55.9	62.2
Family	45.4	36.6	34.3	34.6	37.4
Pre-harvest	29.0	23.6	20.9	20.9	23.2
Harvesting/post-harvest	16.4	13.0	13.4	13.7	14.2
Hired	23.3	24.3	34.1	21.3	24.8
Pre-harvest	13.6	10.5	22.0	12.5	14.3
Harvesting/post-harvest	9.7	13.8	12.1	8.8	10.5
Capital	10.9	8.0	9.1	11.2	10.2
Government Transfers	3.0	6.5	5.5	1.4	3.4
Remittances	- 0.01	-0.1	-0.9	-1.0	-0.6
All Factor Payments	100.0	100.0	100.0	100.0	100.0

Source: Computed from the ZVR-SAM 2003/4 and survey data

Note: Trading and export activities engaged in CF were assumed with: (1) no family labor; (2) hired pre-harvest: 18.0%; (3) hire harvest and post-harvest: 43.0%; and (4) capital: 38.5%

Table B.8. The Structure of HH Income in the Zambezi Valley Smallholder Economy

Income Components	Cotton Growing Areas						Tobacco Growing Areas						All Zambezi Valley Region	
	Non-growers		Growers		All Area		Non-growers		Growers		All Area			
	$US	%	$US	%	$US	%	$US	%	$US	%	$US	%	$US	%
1. Agricultural Income	490.2	63.3	658.5	78.6	615.3	74.7	743.8	70.8	1,817.5	86.4	1,533.9	82.3	1,144.5	79.1
1.1. Food crops	490.2	63.3	473.5	54.7	477.8	56.9	743.8	70.8	944.5	48.1	891.4	54.1	716.1	55.3
1.1.1. Retained food	446.2	59.5	448.7	51.9	448.1	53.9	654.7	63.6	911.7	46.3	843.8	50.9	676.1	52.1
1.1.2. Sold food	43.9	3.8	24.8	2.8	29.7	3.0	89.1	7.2	32.7	1.8	47.6	3.2	40.0	3.2
1.2. Cash crops	0.0	0.0	185.0	23.9	137.6	17.8	0.0	0.0	873.1	38.3	642.5	28.2	428.4	23.8
2. Livestock	72.3	14.2	85.4	10.4	82.0	11.4	79.5	8.6	90.1	5.8	87.3	6.5	85.1	8.6
3. Self-employment	56.0	10.8	32.1	5.2	38.3	6.7	185.9	7.5	90.2	3.8	115.5	4.8	82.8	5.6
4. Wage labor	80.6	12.8	42.2	4.0	52.0	6.2	122.3	10.6	80.8	4.9	91.7	6.4	74.9	6.3
5. Transfers/pensions	0.0	0.0	70.7	3.9	52.6	2.9	64.6	4.1	25.7	1.3	36.0	2.1	43.0	2.4
6. Remittances/net	(6.6)	(1.1)	(16.2)	(2.2)	(13.8)	(2.0)	(25.3)	(1.8)	(44.2)	(2.1)	(39.2)	(2.0)	(28.4)	(2.0)
6.1. Received	17.7	2.4	10.3	1.7	12.2	1.8	10.2	1.5	13.2	1.0	12.5	1.1	12.4	1.4
6.2. Sent	(24.3)	(3.6)	(26.6)	(3.8)	(26.0)	(3.7)	(35.6)	(3.2)	(57.4)	(3.1)	(51.7)	(3.1)	(40.8)	(3.4)
HH Income														
Total ($US/HH)	692.4	100.0	872.7	100.0	826.5	100.0	1,170.8	100.0	2,060.1	100.0	1,825.2	100.0	1,401.8	100.0
Per Capita ($US)	108.6		124.9		120.7		174.7		318.1		280.2		212.6	
Number of Observations	30		87		117		42		117		159		276	

Source: Zambezi Valley Cotton and Tobacco Concession Areas Study 2004

Table B.9. Economic Structure in the Base: Export and Import Shares

Exported Commodities	Shares of Exports: In Total Exports (%)	Shares of Exports: In Marketed Output (%)	Imported Commodities	Shares of Imports: In Total Imports (%)	Shares of Imports: In Domestic Demand (%)
Packed cotton	9.6	100.0	Rice	2.9	74.9
Packed tobacco	73.7	100.0	Beans	1.2	31.7
Maize grain	3.6	50.0	Fruits	0.4	41.9
Groundnuts	3.2	87.5	Coconuts	0.6	100.0
Root crops	0.7	41.9	Meat – cow	6.5	71.8
Vegetables	2.6	45.0	Cooking oil	3.4	100.0
Meat – goat	2.3	32.6	Sugar	2.2	100.0
Meat – birds	0.6	28.6	Salt	2.1	100.0
Alcoholic drinks	1.9	29.6	Tea/coffee	0.2	100.0
Other commodities	1.8	24.0	Seeds	2.3	100.0
			Pesticides	1.5	100.0
			Fertilizers	30.7	100.0
			Other agro-inputs	2.6	100.0
			Fuel	18.8	100.0
			Textile/footwear	9.3	80.6
			Metal/blacksmithing	4.1	77.3
			Soap and hygiene	9.5	100.0
			Imported drinks/tobacco	1.7	100.0
Total	100.0	32.1	Total	100.0	27.4
By Sector			By Sector		
Agricultural	93.4	50.0	Agricultural	5.1	4.2
Non-agricultural	6.6	5.3	Non-agricultural	94.9	39.0
Total	100.0	32.1	Total	100.0	27.4

Source: ZVR-SAM 2003/4

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